Univ. of Penn.-
Towne scientific
school,
Journal

JANUARY NUMBER - May 19



# THE TOWNE SCIENTIFIC SCHOOL JOURNAL

PUBLISHED BY THE
UNDERGRADUATES


VNIVERSITY OF PENNSYLVANIA

# Towne Scientific School Journal

January, 1915

Published by the
UNDERGRADUATES OF THE

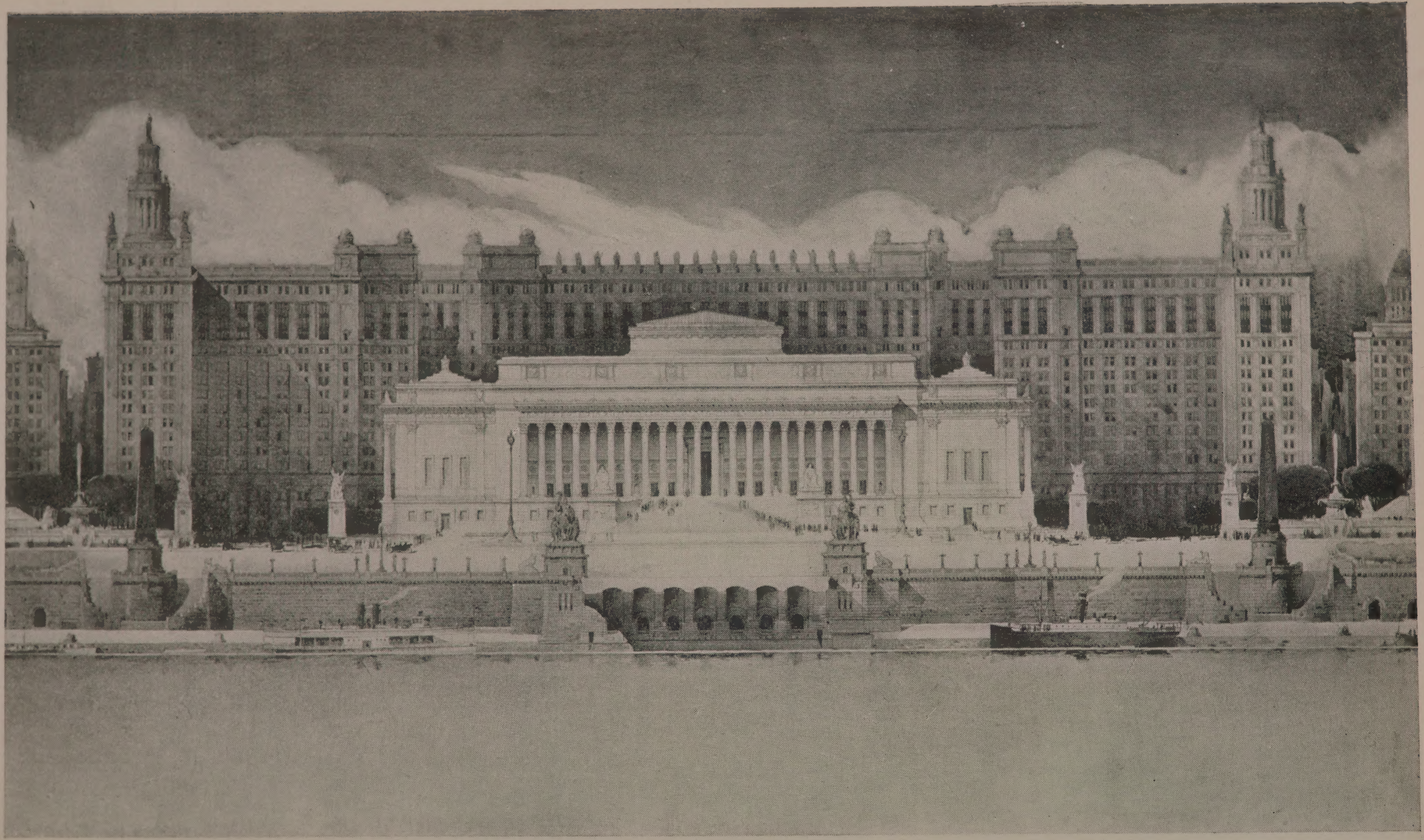
Towne Scientific School of the
University of Pennsylvania

Room 204, Engineering Building, U. of P., Philadelphia, Pa.

SUN PRINTING HOUSE, PUBLISHERS
PHILADELPHIA

# CONTENTS

## January, 1915



Courtesy of Stuart Memorial Fund and American Architect

Elevation of Winning Paris Prize 1914
H. Sternfeld '11

The Towne Scientific School Journal

Vol. II JANUARY, 1915 No. 2

# COMPETITION FOR THE PARIS PRIZE

EUGENE B. BAKER, 1914. LOGIST P. P. 1914.

What the grand prix de Rome is to the student of architecture at the Ecole des Beaux Arts the Paris prize competition is to the student of architecture in America. It is the goal of all our hopes. To be the Paris prize scholar is the highest honor that a man can have bestowed on him during his scholastic career. This is why the competition is so keen and the process of elimination so severe in determining the winner.

The Paris prize is usually given each year as a gift of $2500 from some architect in New York, supplemented by the proceeds from the "grand ball" given by the Beaux Arts Society. The competition is spread over a period of about six months, and is divided into three parts, as follows: First preliminary, second preliminary and final. The first preliminary is a twelve-hour test on the designing of the elevation of a small building. The second preliminary is usually the designing of a group plan at a very small scale, the time allotted being twenty-four hours. The final drawings generally consist of a plan, elevation and section of a group of buildings at a large scale. The first and second preliminary drawings are done by the student "en loge." Outside help is allowable during the process of development of the final drawings. This prize is open to any citizen of the United States without any restrictions whatsoever.

My first sight of a Paris prize competition drawing was in the summer of 1912, when the winning drawings of Donald Kirkpatrick, Arch. '11, were exhibited at the Boston Architectural Club. The first and second preliminary drawings were there also. The three types of drawings there shown—a quick sketch elevation, a sketch plan problem and a finished project—were a revelation and an inspiration to me. The following fall I came to Pennsylvania to finish my study of architecture under the greatest of teachers, Paul P. Cret. Here I wish to say that the inspiration derived from Mr. Cret has been the greatest factor in my architectural career. This I think is emphatically true of all students who came under the influence of his masterly hand. It is our prayer that he be returned to us safe and sound. And yet, even if he should not, I believe that his influence has been of such a character that the men trained under him will continue to carry on his work. Mr. Cret is decidedly of the opinion that a teacher is a guide and not a leader.

In July of 1912 the good word was announced that Douglas Ellington, Arch. '12, had received the Paris prize scholarship of the year previous, owing to Hall's inability to qualify. This gave the prize to Pennsylvania for two consecutive years. Could Pennsylvania triumph the third time? Yes, Grant Simon's victory in 1913 made it possible to have it a third consecutive year. He won in one of the keenest competitions that has ever been held for this prize. That year we had two men in the finals, C. Wilmot Stedman being the other Pennsylvania representative. Stedman dropped out to receive the Stewardson traveling scholarship.

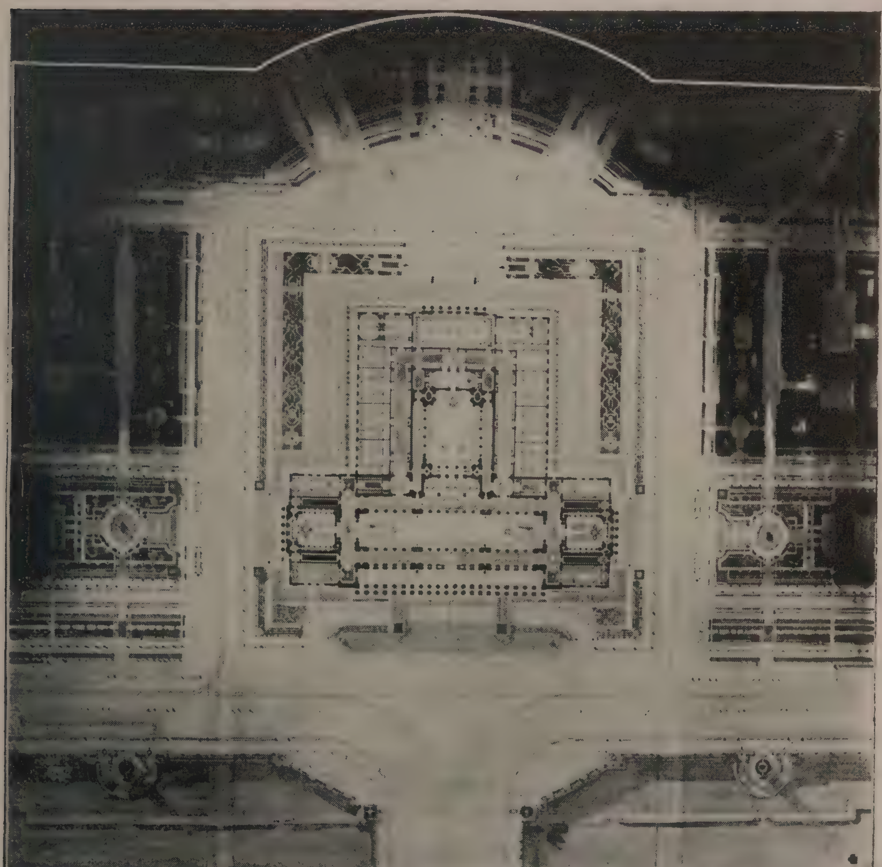
On a cold, dreary morning of January, 1914, a large body of students gathered in old Room 200. Each busied himself arranging all sorts of drawing instruments and materials on his desk. Every one seemed to be intensely alive to the situation, and viewed it with an anxious air. It was an important day—the first preliminary for the Paris prize was to be given out at 9 o'clock. Breathlessly we saw the instructor approach with the program. What was the subject? A bathing pavilion! Groans and "I told you so's" filled the air. The race was on. We had twelve hours to do the problem in. We were all sure we could not finish in that time. Thompson, Chillman, Hunt and others of the "big boys" sat back and smoked, viewing the feverish excitement of the younger men with dispassionate glances. After a time we all started work. By noon our schemes were pretty well formulated, and thoughts of final drawings were in the air.

"Some one rendering!" It sounded like "Car coming!" in a big automobile race. All craned their necks to see the intrepid adventurer who could start to color at this early period. It was not long before we followed him, and signs of finishing were very evident. "Who stole my ivory black?" and like insinuations were rampant, while the poor unfortunate promptly stole from his neighbor's color box. The renderings proceeded very slowly on account of the damp weather outside. By and by Sternfeld, Love, Barney and some of the other men who had been exempt from this preliminary strolled in with a supercilious air and "nosed around." "Only five minutes more!" was shouted. Now the final pound of steam was exerted. I believe I worked over two hours in those five minutes. At last the rush was over and the drawings collected.

In a few weeks the judgment took place and the fortunates had attacks of heart failure. Penn had taken the first three places and second alternate in the following order: Baker, Thompson, Hunt and Chillman.

In February the second preliminary was taken by about twenty-five competitors, one-half of whom were Pennsylvania

men. The competition was held for our men at the T Square Club in the old rooms on Chancellor street. It was to last twenty-four hours. I in particular had a deep laid scheme to incapacitate as many men as possible in some unknown manner, which later worked out beautifully in my favor. There was talk of whether we could have some rest that night, or else work right straight through. Our decision was that we would do as we pleased, which meant that all of us would work like Trojans from the drop of the program. The problem was given out at 9 o'clock. All settled down for the long siege. The program



Plan of Winning Paris Prize, 1914
H. STERNFELD

Courtesy of American Architect

was a rather flexible one, and had as its subject a "lazaretto," the exact meaning of which even today is very hazy in my mind. I know the solution was as hard as the definition of the word. After a while a few schemes appeared, carefully guarded in such a manner that only a good friend of the owner could have a "peek." By night each had his, or somebody else's, scheme and was hard at work in its development. About 8 o'clock we went out to get something to eat, and came back ready for the long night which lay before us. About midnight I, being of a generous nature, donated a little jar of figs and dates to the general good. That little jar I still keep as a remembrance of its usefulness that night.

Barney, Hunt, Love and others were placed hors de combat with a vengeance. It was some hours before they recovered entirely. Barney was compelled to sleep, much to the general rejoicing of the other combatants. At last we were on white paper, and 6 o'clock found us hard at work putting in "poche" and "snapping up" the drawings generally. Love was in his usual charet and working his head off to make a grandstand finish. Barney rushed in, declaring that every alarm clock should be consigned to the flames, and promptly sank into the deep pit of work which awaited him. We were all on our toes at 8.30, attacking our drawings vigorously from all sides, pulling them into shape and trying to make a suitable presentation. At 9 o'clock they were torn from us. "Oh, for another hour!" cried Love, and we promptly scored him for even dreaming of such a possibility. Home and sleep were the thoughts uppermost in our minds, although we lingered for a short while to glance over the drawings and make speculations as to their merits. Hough was universally picked, while Sternfeld and I were lost in the shuffle. Yet in the judgment which followed Sternfeld was placed first, Chillman third, but placed H. C. because he was an alternate. Hough was placed fifth, and first alternate was taken by myself. As Hough was also in the Roman prize, it was decided that I should take his place.

Now the final heat had begun. We went to New York to take the program for the final problem. Here we met our fellow competitors—Hoyt, Moscowitz and Rigaumont. So much depended on the parti of the problem that we worked very hard for twelve hours, and we were both delighted on our return to Mr. Cret to have him say that both were "possible."

We had eleven weeks to develop our schemes, and after a week of sparring we got down to a regular routine of work. We started about 9 o'clock in the morning and worked until about 11 at night. At first we tried all possible variations of our schemes, making a large number of small scale studies and

enlarging the most promising ones. For three weeks we continued in this manner. There seemed no end to it. Won't Mr. Cret ever be satisfied? The subject seemed to be a simple one—a city hall—the requirements not hard to fill; a large auditorium, two smaller ones, four rooms for private consultations, suites for six judges and a mayor, a library, rooms for the attorney, and the necessary vestibules, dependencies and stairways. All the rooms required were on the second floor, and so it was not long before we were entering directly on this level. This was a departure from our preliminary idea of entering on the first floor and ascending by staircases to the main floor. It was a commonplace problem, as we viewed it; but Mr. Cret by his wonderful genius and ideas made it into one full of interest and possibilities. Soon we started work on the elevations, and then the first great point of departure between Sternfeld's and mine took place. Would the surrounding buildings be higher or on a level with the city hall? Sternfeld elected to raise his, while I kept the same cornice line throughout the composition. Sternfeld's idea was to design a building to fit existing conditions, while my idea was to design an entirely new group of buildings. Sternfeld's was full of New York; mine could have been located in any of the enterprising cities of the Middle West.

The weeks moved quickly, and soon Mr. Cret talked of New York and final drawings. The size of them staggered us, for if they worked out according to our small scale sketches they would be immense. Was it possible? We measured again and groaned in dismay. The plan would be about ten and a half feet square and the elevation over eleven feet long. We had never dreamed of such an expanse of paper before.

Up to the time of going to New York we had been allowed to have all the assistance we could muster, and I assure you that it poured in from all sides, and our "support" was perfect. As an example of what was done, I left my section to be entirely designed by a most faithful "nigger," E. Nelson Edwards, here in Philadelphia, and had the rubbing study sent to me in New York. Needless to say the work was splendidly done. Sternfeld worked harder than any man I have ever known, and most certainly deserved to win. He was most ably assisted by a large corps of enthusiastic Pennsylvania men.

We were all ready to go to New York on the 23d of June. Our drawing paper was mounted in this city on "compo" board and sent to New York, and we were terrified when we saw the cases arrive and realized the size of the drawings. The cases were so bulky that they had to be unpacked on the street, and the frames taken up to the fourth floor on the top of the elevator. We went to our coops, or loges, as they were politely termed, and

started to make them livable. I discovered shortly after I started to work that I could not get my plan in the loge, much less assemble the three parts of which it was composed. This was soon remedied, however, as one end of the loge was taken bodily and moved back ten or more feet. This gave us a little breathing space and a chance to emerge whenever the pangs of hunger became too strong. We were fortunate in having a rubbing machine, which saved us many days of hard labor. Thanks to the machine, however, we were soon hard at work inking in.

I had the loge in the rear of the room beside the redoubtable Hoyt, while Sternfeld occupied one in the front. There was very little open rivalry, only deep in each man's heart was the determined idea of winning, and we all worked on with dogged determination. In a few days we found out that the time allotted was totally inadequate for the preparation of the drawings. The time had never been extended before, we were told. Nothing daunted, we asked Mr. Emerson if anything could be done. Precedent was set aside, and we got the time we asked for. The first week we worked from 9 to 7, and the last two weeks from 8 to 12 o'clock. It was not all work, however. There was a great deal of good fun and fellowship mixed in with the monotonous drawing, which seemed never-ending. We would have pitched battles with electric light bulbs as missiles and boards as shields. Whenever the bombardment became too terrific we could beat a hasty retreat to our loges. In a window opposite Sternfeld a row of pretty shirtwaist makers interested him for a while, but even this pleasure had to be denied as the end grew near.

Soon word was whispered around that Hoyt was rendering, and that made us push ourselves to the limit. Now the elevation was all inked in, and put aside to make room for the plan. Time flew and the last week arrived. Having made very carefully rendered sketches of our plans and elevations, Sternfeld and I decided that three days would be sufficient to spend on the rendering of the final drawings. What had taken us a long while before—ten days—to do was now accomplished in the short space of fifty-four hours. Hoyt finished first, and I came second. The others were close on our heels. During all this time we had not seen any other drawings except our own, and the first sight of the other problems was one which caused many varied feelings. I was astounded at the vast amount of work on Sternfeld's and the superb rendering of Hoyt's. The five sets of drawings, three in each set, required a very large space to set them off, and the exhibition room was completely filled up. My plan just touched the ceiling, and some of the others were larger.

Elevation of Paris Prize Problem
E. C. Baker

The judgment took place the following day, and was conducted in the same efficient manner as characterized all the preliminary stages of the competition. The jury met at 1 o'clock, and Sternfeld and I went out to see a show. We came back at 5 and opened the door. All were clustered around one drawing. Mr. Emerson turned toward Sternfeld and said, "It's yours," and it was all over as far as four of us were concerned.

A quotation from the jury's report, published in the American Architect, on Sternfeld's problem is given here. It is quite a masterly summing up of the splendid points of the project which won for Sternfeld a two and one-half years' training at the Ecole des Beaux Arts in Paris: "The solution of this program as shown on the set of drawings submitted by Mr. Sternfeld was remarkably well balanced, the various elements of the plan not only being nicely proportioned and logically placed, but each fulfilling in itself the requirements as laid down in the program."

My plea will be for those who lose. It is true that the goal is to win, but is there not some reward for the loser? "It is better to have loved and lost than never to have loved at all," and this is extremely true in architectural competitions. I learned more during those eleven weeks about design than in all of my previous architectural career. I learned to work and study.

The valuable criticism of Mr. Cret was of such a personal nature that it cannot fail to have some good effects, even though it may take a lifetime to produce them. As Mr. Cret said to me

before I went to New York, "It is a fitting end to a college course in architecture. I think every student should make it his aim to be a finalist in some one of the big competitions held annually in our country, and should work toward this end with all the power and determination that are within him. He may never get through, but what does that matter? One wins when thousands fail. It is not fair to suppose that the results are in the same ratio. As Penn men grow in the field of architecture, I am confident that this growth will be largely due to the tremendous stimulus given by these competitions, and although they in themselves are of small value in the making of a new architecture, the tremendous inspiration derived from them will be of the greatest value in the development and betterment of our national architecture."

## THE NEW ELECTRICAL ENGINEERING DEPARTMENT OF THE TOWNE SCIENTIFIC SCHOOL

by

C. E. Clewell,

Assistant Professor of Electrical Engineering.

To an alumnus or student of the Towne Scientific School it is hardly necessary to state that a complete course in electrical engineering has been given at the University of Pennsylvania for a number of years. Instruction in both mechanical and electrical engineering subjects has heretofore been under one department, known as the Department of Mechanical and Electrical Engineering.

### Reasons for the New Department.

The instruction in electrical engineering subjects in the past has been given by one of the several divisions of the joint department; that is, the division of electrical engineering has previously been co-ordinate with the divisions of experimental engineering, mechanical drawing, and mechanical constructive practice. The growth in the number of students taking electrical engineering and the increasing ramifications of this particular branch of engineering work have led the trustees of the University to establish a new department co-ordinate with and on exactly the same footing as the Mechanical, Civil and Chemical Engineering Departments of the Towne Scientific School.

The first and most important step following this decision was the selection of a man as the first incumbent of the newly created chair of electrical engineering. Such a man should possess a wide practical experience in the engineering field, and also

an extensive teaching experience. To those who have given a problem of this nature some thought, it will be evident that the choice of a man for a position of this kind is peculiarly difficult for a number of reasons.

The trustees, with the co-operation of the alumni, who were especially interested in this new move, after a careful study of the situation invited Dr. Harold Pender, then director of the Electrical Engineering Research Department at the Massachusetts Institute of Technology, to take charge of this new department, and he entered upon his new duties at the University last September.

Doctor Pender possesses in an unusual degree the qualifications for this important work. He has had a wide practical engineering experience in connection with various engineering developments and investigations, and also an unusual teaching experience. During his graduate study at Johns Hopkins University he served as laboratory assistant and instructor at that place, and after graduation as instructor at McDonogh School and at Syracuse University.

This period of teaching was followed by several months in special research work abroad. Upon returning to this country, he took up the practice of engineering, being connected successively with the Westinghouse Electric and Manufacturing Company, the New York Central Railroad, and with Cary T. Hutchinson, of New York city. While associated with Mr. Hutchinson he was engaged in various lines of consulting work, particularly in hydro-electric developments and steam railroad electrifications. Following this period of five years in engineering practice, Doctor Pender was appointed professor of electrical engineering at the Massachusetts Institute of Technology, and in 1913 was made director of the research division of the Electrical Engineering Department of that institution. While at the Massachusetts Institute of Technology he was also engaged in such consulting work as was consistent with the duties of professor of electrical engineering. He spent the summer of 1913 in Europe, making a study of trackless trolleys as used in Great Britain and on the continent. Doctor Pender is a fellow of the American Institute of Electrical Engineers, and has served on a number of its committees, particularly the Standards Committee and the High Tension Transmission Committee.

Doctor Pender has contributed scientific and engineering articles to various technical journals, is the author of "Principles of Electrical Engineering (McGraw-Hill Book Company) and editor-in-chief of the "American Handbook for Electrical Engineers (John Wiley & Sons).

## DISTRIBUTION OF INSTRUCTION.

The policy of the new department is to gather in the instructing staff men who are experts in at least one of the more important phases of electrical engineering. It seems desirable to place the instruction in each branch of electrical engineering in the hands of such an expert. The field is now so large that it is impossible to get together a staff of men sufficiently proficient in all branches of electrical engineering to be thoroughly familiar with all phases of the subject. Consequently, in laying out the work of the instructing staff, each of the senior members has been put in direct charge of the particular work in which he has had the greatest experience. This policy has resulted in the following assignment of courses for the current year, the men in charge being assisted in each case by the younger instructors.

Doctor Pender gives the courses in alternating current machinery, distribution and transmission, and electric railways.

The writer, who came to the University this fall from the Sheffield Scientific School of Yale University, gives the courses to non-electrical students taking work in the electrical department, supervises the work in the dynamo laboratories, gives a short course to the junior electrical engineers in direct current machinery, and a course in the industrial applications of light and power to the senior electrical engineers.

Doctor Trueblood, who is a Ph. D. in physics from Harvard University in 1913, and who has been connected with the Department of Physics in that University for the last two years, is in charge of all work in the instrument laboratory, and gives the course in electricity and magnetism, which forms the basis of the strictly technical side of all the advanced electrical engineering work. Doctor Trueblood will probably also develop courses in telegraphy and in telephony and in wireless telegraphy.

The younger instructors assist the older members of the staff by conducting recitations (the classes being divided into small sections for this purpose) and in the immediate supervision of the performance of experiments in the laboratories. In the assignment of work to the various instructors, the experience of each in the particular branch assigned has been carefully considered, and the number of subjects assigned to each instructor has been reduced to a minimum by so *staggering* the hours of recitation periods that in many cases one instructor can give all the recitations in a particular subject. The object of this arrangement is to enable each man to confine his attention to a few subjects, which he can thoroughly master, rather than to attempt to give instruction in a large number of subjects covering the general field of electrical engineering. The writer, both for himself and for the professor in charge, wishes here to express apprecia-

tion for the hearty co-operation shown by the entire instructing staff during the past months.

New Offices of the Department.

The room formerly called "the standard room," at the southwest corner, first floor, of the engineering building, has been converted into two offices, which are now occupied by the professor in charge and the assistant professor of electrical engineering. The various offices of the instructing staff are located, as formerly, in different rooms provided for that purpose on the first and second floors of the engineering building. Up to the present time the distribution of laboratory space has not been modified, the instrument laboratory being located in the eastern portion of the first floor, the direct current laboratory to the west on the first floor and the alternating current laboratory at the northwest corner of the second floor.

The excellent equipment already in the laboratories of the electrical engineering department, and the thorough training of the students up to the present point in their technical courses have made the transition of the work from a division of mechanical engineering to an independent department less difficult than might at first be supposed. Great credit is due Professor Spangler, and also Professor Temple, for the work accomplished by them in the past. For the present year, only such minor changes have been made in the curriculum as were deemed advisable under the new conditions incident to the enlargement of the staff. Instruction in electrical engineering throughout the country is passing through a period of readjustment, and more radical changes may be found necessary in the future.

Minor Changes in the Curriculum.

The changes in the curriculum for the present year are the following: In the Junior year a course in *Differential Equations* has been included in order to render possible a more thorough treatment of certain technical subjects during the Senior year. The course in *Electrical Measurements* formerly given in the Senior year has been shifted to the Junior year. Certain changes in the titles of courses have also been made, as, for example, the changing of the title *Electro-Dynamics* to *Principles of Electrical Engineering.* In the Senior year the time allotted to *Hydraulic Machinery* and *Heat Engineering* has been increased by one hour for each subject. To provide the necessary time for the new courses introduced in the Junior year, the Junior *Seminar* course, the courses formerly known as *Electrical Engineering* 2, and that in *Crane Design* have been omitted. The course in *Power Plants* In the Senior year for these students, the courses formerly known to the first term, and the course in *Electric Power Plants* has been

shifted to the second term, the idea being to make the latter course a continuation of *Power Plants*.

The course formerly known as *Advanced Electro-Dynamics* is replaced by a new course in *Illumination and Motor Applications*, and that formerly called *Advanced Alternating Currents* is now termed *Alternating Current Machinery*. The work in *Electrical Design* has been omitted, and in its place has been substituted a course in *Distribution and Transmission*. The essential features of electrical design are taken up in the work of *Alternating Current Machinery*, but emphasis is here laid primarily on the operation and testing of machinery.

In the work given to non-electrical students special care has been taken to adapt the instruction given these men to their particular needs. With this end in view the courses in *Electro-Dynamics* and *Alternating Currents* formerly given to the Junior mechanical and chemical engineers are now known as *Elements of Electrical Engineering* and *Electric Machinery*, respectively. given by the mechanical engineering department has been shifted as *Applied Electricity* and *Electrical Laboratory* now bear the titles *Industrial Applications of Electricity* and *Electric Machinery Laboratory*.

The question of a certain number of optional courses in the Senior year is now under consideration by the department. It is impossible for any one student to master the entire field in a four-year course and this naturally suggests the possibility of introducing optional work in the curriculum of the Senior year, from which the student may make a selection and thus begin to shape his activities to conform to the line of work he contemplates after graduation. It is also probable that in time the desirability of giving graduate work in certain courses will demand attention.

### THOROUGHNESS EMPHASIZED.

The aim of the new department is to drill the students thoroughly in a few things, instead of making an attempt to cover a large number of topics at the expense of thoroughness in each. This is in keeping with modern ideas of engineering education, and to this end an effort has been made at the very outset to reduce the number of courses, and to devote more time to branches which may be classed as particularly important. From the standpoint of the student, as well as that of the instructing staff, this plan has many points of excellence. The professor or instructor who assigns material in the text-book, and gauges the value to the student by the number of pages assigned, is apt to find at the end of the term that the student knows far less than he realizes.

### CO-OPERATION OF THE STUDENT BODY.

The attitude of the student body has been all that one could desire, under circumstances which have been rather trying at

times during the first months of the formation of this new department. Such an attitude has been of the utmost help to the staff in its attempt to carry out the plans as originally contemplated. When beginning work of this kind, there is always a likelihood of conflicts in the drafting of rules and regulations and similar items, and in all cases where such minor difficulties have arison, the students in the various classes have shown a spirit of co-operation to an unusual degree.

The distribution of students registered in the four engineering departments of the Towne Scientific School for the present year is as follows:

| Course. | Fresh. | Soph. | Junior. | Senior. | Total. |
|---|---|---|---|---|---|
| Civil Engineering.......... | 55 | 41 | 42 | 40 | 178 |
| Mechanical Engineering.... | 42 | 29 | 32 | 29 | 132 |
| Chemical Engineering...... | 32 | 25 | 23 | 25 | 105 |
| Electrical Engineering...... | 61 | 37 | 33 | 40 | 171 |
| Total Engineering .... | 190 | 132 | 130 | 134 | 586 |

## THE TORRESDALE FILTRATION PLANT

Malcolm Duncan, C. E., '15.

The Torresdale filtration plant, the largest works of this kind in the world, is situated at Delaware avenue and Pennypack street, in the Forty-first ward. It has an average daily capacity of 240,000,000 gallons and covers an area of 200 acres. Market street is 100 feet wide between house lines; and 240,000,000 gallons would cover Market street to a depth of 100 feet from Delaware avenue to Seventh street. Provision is made for future extension.

The plant consists of an intake, a low lift pumping station, preliminary filters, final filters and a filtered water basin. At the present time no provision is made for sedimentation. It supplies filtered water to that portion of the city between the Delaware and Schuylkill Rivers lying below the seventy-fifth contour.

### Intake.

The intake is approximately 700 feet in length and carries the raw water from the Delaware River to the pump well in the engine house. It is of reinforced concrete construction, 14 feet wide and 10 feet 6 inches high. The intake is provided with two gate houses, one at the outer end, the other at about the half-way point. The inner house was originally intended to admit water to the intake from a sedimentation basin that was to be built in the river. This plan, however, has not been carried out.

These gate houses contain the concrete intake chambers, the latter being provided with shut-off valves and removable screens.

The valves are operated by electricity, while the screens are raised or lowered by hand. These screens—four in number—are for the sole purpose of removing sticks, grass, cakes of ice and such materials of a large size that might become lodged in the system at some point and cause trouble. They are removed once or twice a day, and all the material clinging to them removed. The chambers are covered with houses of granite and brick.

## PUMPING STATION.

From the pumping station the water is pumped directly onto the preliminary filters. The elevation at the Delaware River intake (mean tide) is 5.5, and that of the pre-filters is 34, so that the pumps have a lift of 39.5 feet. Arrangements are also made whereby the pumping station furnishes water under pressure for the cleaning of the preliminary and final filters whenever necessary.

The station is equipped with six 40,000,000-gallon R. D. Wood centrifugal pumps driven by Reeves cross-compound engines; one 40,000,000-gallon Allis-Chalmers centrifugal pump, driven by a Bates cross-compound engine; one De Laval steam turbine, driving a centrifugal pump of 50,000,000 gallons capacity. Two De Laval turbines driving centrifugal pumps of the same make, of 1,000,000 and 2,500,000 gallons daily capacity, respectively, provide the water for the washing of the final filters. Two De Laval turbines driving De Laval pumps, each of 5,000,000 gallons capacity, furnish water for washing the preliminary filters. One Deane motor-driven triplex pump completes the pumping appliances of the station.

Three 75 Kw. generators driven by De Laval turbines, direct connected, furnish all the electricity for the lighting and operation of the station.

The large centrifugal pumps are placed directly over the pump well. They are of the double-suction type, approximately 7 feet in diameter. Two 30-inch suction pipes feed each pump at its centre. The discharge pipe is 36 inches in diameter and leads to an 11-foot main. The water is pumped through this conduit upon the preliminary filters, or these may be by-passed and the slow sand filters supplied directly with the raw water.

The boiler house contains nine 300-H. P. Heine boilers. They are equipped with Sturtevant economizers and Murphy stokers. They are of the water-tube type of boiler, having 189 3½-inch tubes 18 feet long each.

## PRELIMINARY FILTERS.

The raw water of the Delaware River is pumped directly upon the preliminary filters through the 11-foot riveted steel pipe encased in concrete. The water enters the filters from their rear by means of a 7-foot conduit if two rows of filters are to be fed,

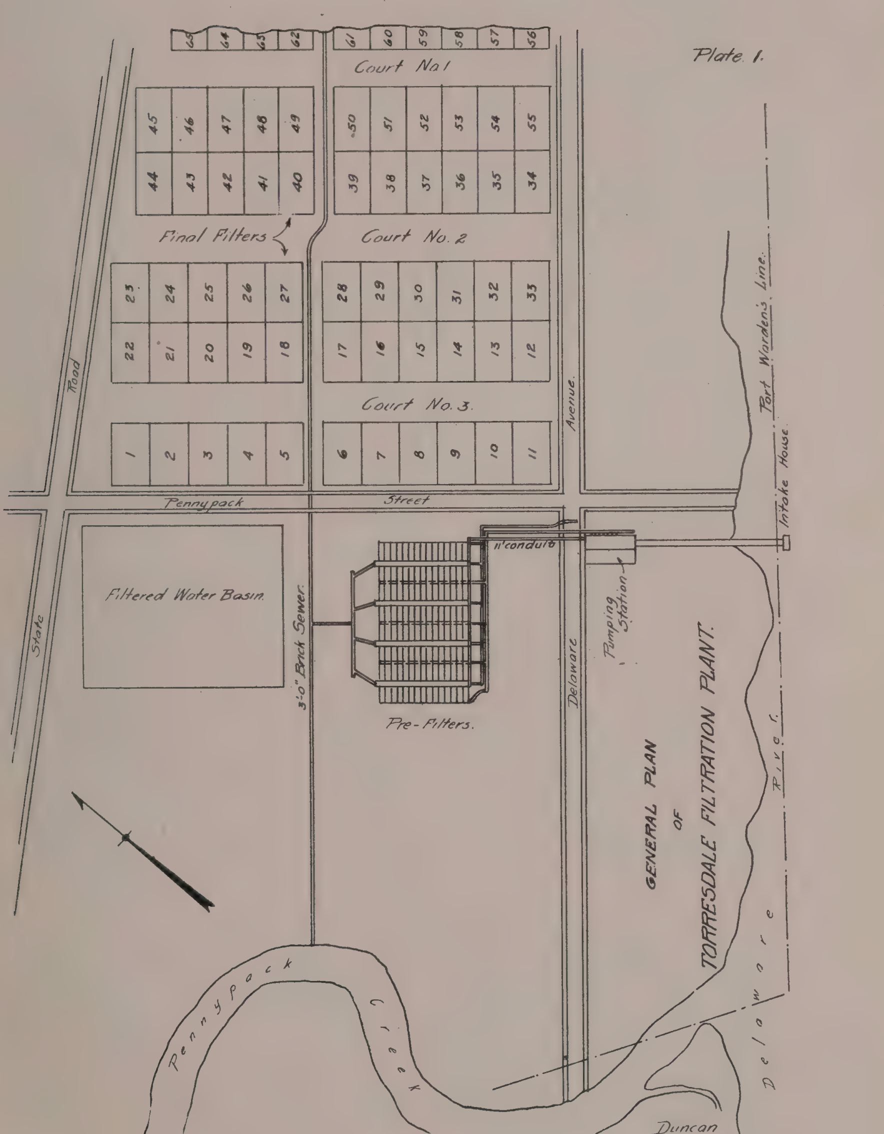


Plate. 1.
Court No 1
Final Filters
Court No. 2
Court No. 3
Pennypack Street
State Road
Filtered Water Basin.
3'-0" Brick Sewer.
Pre-Filters.
11' conduit
Pumping Station
Delaware Avenue.
Port Warden's Line.
Intake House.
GENERAL PLAN
OF
TORRESDALE FILTRATION PLANT.
Delaware River
Pennypack Creek
Duncan

or through 5½-foot conduits if only one row is to be fed—all of these connecting to the main 11-foot conduit. These conduits are formed by the rear walls of the filter beds and are covered with a concrete roof.

The filters, 120 in all, are of the mechanical type, requiring air and water to clean them. At Torresdale the coagulant is omitted. These filters are arranged in batteries of 15, with two batteries facing each filter house, thus making four such houses. Each filter unit is 20 feet 3 inches in width, 60 feet long and approximately 14 feet in height.

Reinforced concrete constitutes by far the largest part of the material used in the construction of the filters. The roof, walls and floor are all of concrete, while the filter houses are faced both inside and outside with brick. The roof is carried by heavy I beams resting on concrete piers and spanning the entire width of the bed. The roof is covered with sand and gravel to provide for drainage. Ample provision is made for air and ventilation, there being seven 3-foot manholes in each filter unit. The manholes are provided with screens to prevent the entrance of any foreign matter into the filters.

The filtering material consists of a 42-inch layer of graded gravel, so arranged that the finer grades are placed on top. The water stands at an average height of four feet on the filter bed.

The water after passing through the filtering material enters the side collectors. It runs from these into one of the large reinforced concrete collectors which extend the entire length of the bed. It then passes through a hydraulic valve and an automatic effluent controller into the effluent gullet. This is located directly under the operating floor of the filter house and is of reinforced concrete construction. It then passes to the main effluent, an 11-foot conduit of exactly the same construction as the main influent. The partly filtered water then passes by gravity to the slow sand filters.

### The Wash-water System.

The wash water is supplied through 30-inch mains laid directly on top of the effluent gullet. By means of hydraulical valves the water is admitted to 20-inch spiral riveted, galvanized iron pipes suspended from the roof of the filter, running to the centre of the same. At this point four 12-inch pipes branch out toward the four corners of the filter. These in turn connect with smaller pipes which are directly above the filtered water collector. Connections are then made to the manifolds by 8-inch vertical pipes. The above arrangement of piping allows the pressure to be nearly equally distributed over the filter bed. This latter condition is highly important for the proper cleaning of the filters.

The wash-water troughs consist of a concrete gutter running

the entire depth of the filter and 12 wrought iron laterals branching out at right angles to it. The top of the laterals are placed approximately 12 inches above the sand and pitch toward the central gutter, so that the water flows from the laterals into the central gutter, thence to the front of the filter through the effluent valve into the waste water gullet.

In order to supply the wash water under pressure a reinforced concrete tank has been constructed. The floor of the tank is 27 feet above the filter bed. It is also for the purpose of providing storage for the wash water when the conditions are such that the beds require frequent washing.

The sand is agitated by means of compressed air. The main supply pipe consists of a 20-inch main suspended from the filter house roof. The compressed air is pumped through this pipe into the manifold of each filter. The air is supplied by a motor-driven blower, one in each filter house.

## Method of Cleaning the Filters.

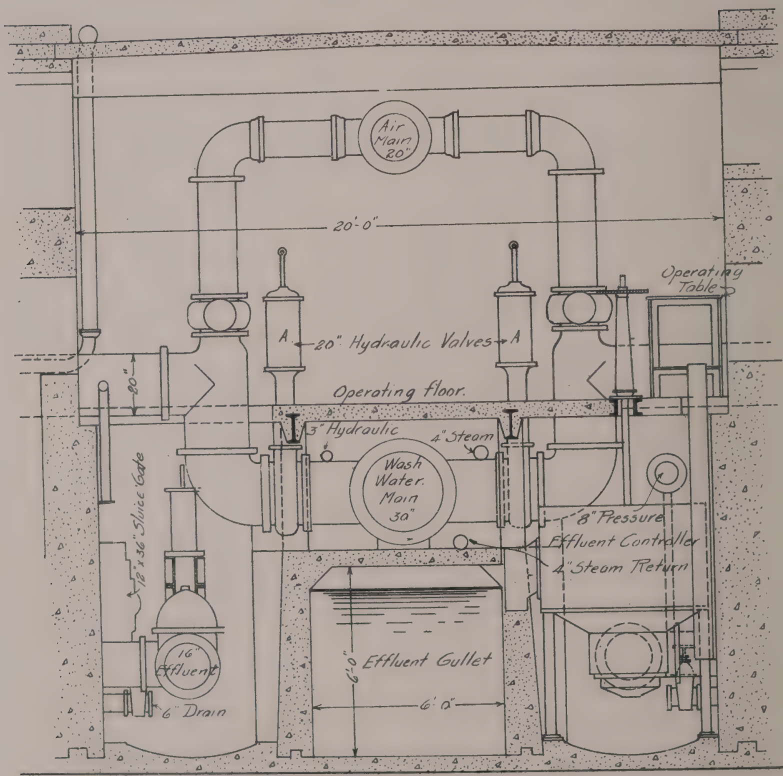
Varying conditions determine the frequency with which the filters are cleaned. If the demand is very large, or the water contains much material in suspension, they will require frequent washings. On the average they are cleaned once in every 24 hours. The exact time for cleaning them is determined by the loss of head gauges on the operating stands. When they show that the loss of the head is such that the filters are no longer operating economically they are cleaned in the following manner:

The raw water valve is closed to prevent the entrance of any water to the filter. The waste water valve is then opened, which allows the water to pass into the waste water gullet by means of the wash water troughs until the surface of the water reaches the top of the troughs. The water is allowed to filter through the sand until there remains about nine inches of water on the filter. The effluent valve is then shut and the compressed air is blown through the filter for three minutes. This separates the sediment from the sand. The air valve is then closed and the wash water valve opened. This allows the water under pressure to flow through the sand and carry the sediment to the top. The water rises and overflows into the wash water troughs, thence to the wash water gullet. After a run of five minutes the wash water valve is closed, followed by the closing of the waste water valve. The raw water is then allowed to flow on the filter, when it is ready for operation again.

Controllers for regulating the output from each filter are automatic in action and so constructed that the rate of discharge may be set to deliver any amount between one and three million gallons per day. They are provided with indicators showing the

Plate 2

TORRESDALE
RAPID SAND FILTERS




Cross Section Through Filter House.

Duncan

rate of discharge in million gallons per day. The loss of head in the controller, when discharging at the rate of 2,000,000 gallons per day, shall not be more than 9 inches, and when discharging at the rate of 3,000,000 gallons per day it shall not exceed 12 inches.

### Final Filters.

The final filters, 65 in number, are of the slow sand type. They are arranged in batteries as shown in plate No. 1. The filters are all rectangular in shape, 43 measuring 140 feet 8 inches by 235 feet eight inches, and 22 measuring 132 feet 2 inches by 253 feet 2 inches. Each filter has an approximate area of three-fourths of an acre, thus giving a total filtration area of 50 acres.

The filters are generally of concrete construction. The floors are built of concrete in the form of inverted groined arches, placed on a puddle lining carried up all around the outside walls of the filters one foot above the filtered water line.

The roof is of a similar construction, and has a covering of sand and gravel to allow for the drainage of the surface water.

The collector system consists of a 30-inch main collector running the entire length of the filter. It is constructed entirely of concrete, and is covered with concrete floor slabs. The lateral collectors are 8-inch standard vitrified terra cotta pipe, which enter the main collector at the top. The laterals are placed on the bays, 15 feet on centres, laid with open joints and perforated all around from end to end. The open ends are plugged to prevent the entrance of the filtering material into the collector system.

The filtering material consists of a gravel layer 16 inches thick, the gravel ranging in diameter from 6 inches to 2 inches. On top of the 2-inch gravel layer is placed sand to a depth of 40 inches. In all there are 18,000 cubic yards of gravel and 92,000 cubic yards of sand in the slow filters.

The piping system for the final filters is quite intricate. This consists of the supply, effluent, refill, raw water drain, overflow, pressure lines and numerous minor lines of varying size. The supply, effluent and pressure mains vary considerably in diameter in the length of the court. For example, the diameter of the effluent main varies from 24 inches to 60 inches, increasing in size as the auxiliary supply from each filter empties into it.

The filters are operated from double regulating houses, in which all the valves and operating mechanism are placed. They are operated at a uniform rate of 4,000,000 gallons per acre per day. This rate is always maintained, regardless of the loss of head in the filtering bed, by means of an automatic effluent regulator. The filtered water is discharged into the effluent pipe under the court. This is connected with a reinforced concrete conduit, horseshoe shaped, and equivalent to a circular pipe 10 feet in diameter, which carries the filtered water to the filtered water basin.

## METHOD OF CLEANING FILTERS.

The influent valves are closed and the water is allowed to filter through the sand until it reaches a level about a foot below the surface of the sand. Laborers then enter the filter and with the ues of shovels remove about two inches of sand and place it in convenient piles throughout the filter. The depth of the sand layer removed depends upon the depth to which the sand has been discolored, but the above figure is an average value.

The sand is cleaned by means of a Nichols sand separator and a Korting ejector. For a detailed account of this method and the results obtained consult Engineering Record, Vol. 70, No. 23.

The advantages of the double system of filtration—that is, the use of the rapid and slow filters—over the single system are as follows:

(*a*) To increase the total output of the filters.
(*b*) To reduce the unit cost of filtration.
(*c*) To increase the efficiency of the filter.

All three of these objects have been attained, as the following results show. (Obtained from the report of the Bureau of Water, 1909.)

The final filters give a maximum daily yield of 6,000,000 gallons per acre, whereas the average rate is approximately 4,000,000 gallons per acre per day. The average run between cleanings is 47 days. Before the pre-filters were in operation the maximum daily rate was equal to the present average rate, and the length of run was only about 20 days. With the present system all the sediment is removed from the water, and bacterial tests show an efficiency of 99 per cent. At times this will run as high as 99.6.

## FILTERED WATER BASIN.

The water is delivered to the filtered water basin from the final filters by gravity. The relative position of the basin is shown on plate No. 1. It is rectangular in shape, measuring 601 feet by 762 feet. The available depth is 15 feet, and the capacity is 50,000,000 gallons at normal water line. The basin is of reinforced concrete construction similar to that of the final filters.

The filtered water is admitted to the basin through an inlet gate house at the north corner. The water can be shut off from the basin entirely so that it can pass directly into the Torresdale conduit.

The Torresdale conduit—a tunnel 10 feet 7 inches in diameter cut through the solid rock 100 feet below the ground surface—carries the water to Lardner's Point Pumping Station, over two and one-half miles distant. From this point it is pumped into the distributing mains directly to the consumer.

# POWER PLANT EFFICIENCY ENGINEERING

By Charles L. Bruff, *Combustion Engineer, United Gas Improvement Company, of Philadelphia.*

Editor's Note.—The following paper was delivered before the Whitney Engineering Society at their meeting on Friday, November 20th. As there is very little written on Power Plant Efficiency along such practical lines, this talk should prove very interesting to many of the Journal readers.

Power plant efficiency engineering is a branch of mechanical engineering which has developed very rapidly in the last few years. As you probably know, there has recently been a very general tendency towards increased efficiency in nearly all branches of industry in this country, due to a realization that our natural resources are not inexhaustible and that we have been far behind other countries in conservation of these resources. The price of steam coal, as well as of other raw materials, has increased from year to year, and this increase in price has caused the owners and managers of industrial plants to realize that less attention has been given to their power plants than to other branches of their business, and that it was possible to save a large proportion of their fuel bills by giving more attention to the economical generation and utilization of power, and that a thousand dollars a year saved in the fuel bill was as good as a thousand saved in any other department. The large electric companies have given more attention to power plant efficiency than have industrial concerns, as their primary object is the economical generation of electric power, and this is mainly dependent on the efficiency of their steam plants, while in industrial plants power is an auxiliary, and in many cases is charged into the manufacturing cost at so much per unit, pound, ton, etc., and if the cost of power is high the consumer foots the bill.

One manufacturer told me that up to two years ago, when "hard times" came along, he did not care how much his power cost; that what he wanted was plenty of good, hot steam, and that "Bill," his chief engineer, who had been running things for 20 years, always gave it to him. Business had not been flourishing lately, so he had looked around for a chance to cut expenses and thought he might save something in his power plant. His fuel bill was about $60,000 a year, and from a very brief inspection of the plant I was convinced that 20 per cent. of that amount, or $12,000 a year, could be saved by correcting existing faults, and almost entirely without expense for new equipment. You may think this is an exceptional case, but it is not, and I feel safe in saying that there are dozens of plants in the vicinity of Philadelphia, many of them of large size, in which an experienced power plant engineer

could effect savings amounting to many thousands of dollars, if given the opportunity. When you consider that the average daily operating efficiency in boiler plants of industrial works does not exceed 60 per cent. and that it is possible in most cases to bring this efficiency up to 70 per cent. and maintain it at that point, and that this 10 per cent. increase in efficiency means a decrease in fuel consumption of over 16 per cent., you can see the possibilities for improvement in economy in the steam generation alone.

In many industrial plants the possibilities for economy in the utilization of power are greater than in its generation, though greater expenditures are generally necessary to produce the saving. As an example of what can be done, I will give the case of a large works in Philadelphia in which the steam plant is an auxiliary—that is, steam and steam generated power are used in the manufacture of the product turned out by the plant. About four years ago it was decided to completely overhaul the mechanical equipment of the plant and bring it up to a point of maximum efficiency. The boiler efficiency was increased from 58 per cent. to 70 per cent., coal and ash handling machinery was installed in the boiler rooms, excess waste heat was utilized, steam wastes were reduced to a minimum, and electric motors furnished with power generated by economical units were installed in place of small and uneconomical steam engines. The result was a net saving of $35,000 a year on a total investment cost for new material of $65,000, the cost of power per unit of product being reduced about 40 per cent.

The rated boiler capacity of this plant was only about 4000 H. P., and the figures give an idea of what can be done by the power plant efficiency engineer in the average steam plant in this country today.

The business of the power plant efficiency engineer is to see that every dollar that is spent for fuel buys the greatest possible value in heat units that can be obtained, and that as large a percentage as possible of the heat units in this fuel is delivered to the machinery or manufacturing processes.

Having outlined the work of such an engineer and the possibilities of success which may attend his efforts, it now remains to take up the details of the work itself and try to show in a general way the faults usually found in power plants and how these faults can best be remedied and how the wastes resulting from them can be eliminated. As this is not a technical paper, but only an informal talk, I am going to assume a concrete case which may apply to any one of you engineers, who, upon graduation, decides to take up power plant efficiency work. Before going on with our man, however, let me say that if any of you object to getting hot and dirty and mixing up with "rough-necks" of all nationali-

ties, don't take up this work, but tackle the designing end or some other branch of engineering. Because, to become a competent power engineer, you will have to get right into the fire and engine rooms and learn the practical end of the work, for you cannot get it in an office or out of books. Let me say also that I am convinced that there is no other branch of the mechanical profession which today offers so many opportunities for success as that of power plant efficiency engineering, as it is a comparatively new field. The time is coming when instead of hiring ignorant and poorly paid men as firemen, large steam users will realize that it will pay to employ technical men at good salaries as fireroom operators, not to do the actual manual labor, but to see that the fuel for which they are paying is so used that it will yield them the greatest return on the money invested in it.

A 3000-H. P. plant operating only 10 hours a day will burn about 16,000 tons of coal in a 300-day year, which at $3.00 per ton will amount to $48,000 a year.

A good combustion engineer put in charge of such a boiler plant should at least be able to increase the efficiency 3 per cent., which would mean a net saving of 5 per cent. in fuel, or $2400 a year. If he were paid a salary of $1500, and replaced a water tender who was getting $900, the net saving for the concern would be $1800 a year, and the figures on possible saving above given are almost a minimum. It is difficult to convince plant managers who are not technical men that cheap and ignorant fireroom labor is a costly thing, but they are waking up to it now, and the next few years should show marked improvement in power plant operating conditions, and many opportunities will be given technical men to take up this line of work.

To get back to our graduate who has decided to go into power plant work, let us suppose that he is given a position with a concern which manufactures some finished product. I will assume that this man is one of you present here tonight, and will use the second person in speaking of him. If the manager employs you for the purpose of bringing about increased plant efficiency he will probably not put you under the operating engineer, but directly under the plant superintendent, who may or may not be a technical man, but who certainly will be a busy one, and one who has little time to listen to long verbal discourses on what you discover or propose to do. Having been through the mill and having made many mistakes and received a number of hard jolts, I am going to tell you what I would do and not do, if I were in your place, and one thing I surely would not do is bother the superintendent any more than is necessary.

The place to start is in the fireroom, where steam is being generated, and the first thing to do is to get a thorough working

knowledge of the plant. If you are hired for efficiency work, you will not at first be an operating man, but you must learn every detail of the boiler plant from the ash pits to the roof. Until you do know the plant thoroughly, let me advise you to leave the operators alone, especially the chief engineer, for if you start out by antagonizing him, or even the firemen, you may have a hard road to travel, and end by doing more harm than good. The chief engineer may be an old-timer, who knows his work thoroughly and holds his job because he has proved his ability to keep up steam and his machinery ready for service under all sorts of adverse conditions. He may not know anything about B. T. Us or $CO^2$, but that may not be his fault, and if he has held the job for years, and has given satisfaction, he deserves to be respected, and you will probably find that his superiors do respect him. He may not appear to think much of you, an inexperienced University man, but he probably respects you for the technical knowledge you have that he never can get, and if you can show him that you are there to help him, and not to take his job away from him, it will make things easier for you. Try to work with the operating force and not against them, unless you find you cannot get results in this way, then you will have to fight or quit and we will assume that you are not a quitter.

As soon as you are thoroughly familiar with the fireroom you will be ready to look for existing faults. We will assume that the plant is provided with only the simplest and cheapest efficiency instruments, a draught gauge, flue gas thermometer and Orsatt or similar apparatus for flue gas analysis. If there is also a water measuring device which will give you the total amount of water fed to the boilers from hour to hour, and if your coal is accurately weighed, your work will be made easier, but unfortunately comparatively few plants measure their feed water, though most of them weigh coal. If you have a water-measuring device, take the first opportunity you have to test its accuracy, as there have been many cases of misleading results having been obtained because of the errors of such devices. If you have no such device, or even if you have one, which you are sure is correct, and which shows that your daily operating efficiency is below 70 per cent., either your boiler is not efficient as a heat-absorbing medium, or your furnace is subject to preventable losses, or both may be inefficient.

Nearly all standard forms of boilers are efficient steam generators, and losses in them can be attributed to their not being kept in good physical condition. At the first opportunity make a thorough internal examination of each boiler, noting the thickness and quality of scale; also determine how long boilers are operated between cleanings and the cost of cleaning a boiler and

the method used. Unless you get into a very poorly operated plant you will probably find that there is small loss due to scale, as operating engineers know that badly scaled boilers are dangerous and are poor steamers, and generally clean frequently enough to avoid serious loss from this source.

You will probably find that much less attention is paid to the condition of the fire side of heating surfaces than to the water side, and the loss of efficiency due to carbon deposit is much greater than that due to scale. Examine the surfaces, and if you find them coated with caked carbon have this cleaned down to the iron, and try to have the surfaces blown at least once a day to remove the loose dust. Tests have proved that boilers which have not been blown for three or four days have shown a decided decrease in efficiency, and it has been authoritatively stated that a carbon formation of 1-16 inch thick on heating surfaces will reduce the conductivity 20 per cent. Your flue gas thermometer will serve as a fairly reliable check on the physical condition of the boilers, and it is generally true that if boilers are operating at less than 150 per cent. of capacity, the temperature of the stack gases should not be more than 150° above the temperature of the steam in the boiler, and if this rise in temperature is exceeded it indicates foul heating surfaces and the boiler should be cleaned, though it may be due to other causes.

At the same time you are taking steps to see that heating surfaces are kept clean, you should be investigating furnace conditions, and this can be done by observation and by the use of your draught gauge and flue gas analysis apparatus. You know the principles of combustion and that the maximum furnace efficiency will be obtained when the average analysis of waste gases in your stack shows the maximum $CO^2$ with no unburned CO. Excess air in considerable quantities must be supplied to all boiler furnaces so far designed or complete combustion cannot be obtained, but as this excess is increased above the required amount the proportion of $CO^2$ in the gases decreases and the oxygen increases, and the heat generated by the fuel is wasted in heating the excess air. The table shows the $CO^2$, excess air, and preventable loss due to excess air. (See table.)

CO AND FUEL LOSSES.*

| Per cent. CO | Air excess, Per cent. | Fuel loss, Per cent. | Preventable loss, Per cent. |
|---|---|---|---|
| 15 | 38 | 12 | 0 |
| 14 | 47.8 | 13 | 1 |
| 13 | 59.2 | 14 | 2 |
| 12 | 72.5 | 15 | 3 |
| 15 | 88.1 | 16 | 4 |
| 10 | 107 | 18 | 6 |
| 9 | 130 | 20 | 8 |
| 8 | 158.7 | 23 | 11 |
| 7 | 195.7 | 26 | 14 |
| 6 | 245 | 30 | 18 |
| 5 | 314 | 36 | 24 |
| 4 | 417 | 45 | 33 |
| 3 | 590 | 60 | 48 |
| 2 | 935 | 90 | 78 |
| 1 | 1970 | .. | .. |

* The table given above assumes that the fuel is pure carbon. It is impossible to compile a table that will apply to all bituminous fuels for the reason that the carbon percentage is not constant. The excess air figures are a little high for bituminous coal, 14 per cent. CO may, however, be taken as the standard of good practice for all fuels.

If your plant is about the average you will probably find your gases contain around 8 per cent. $CO^2$ and no CO (unless your furnaces are badly designed) and you should be averaging at least 12 per cent. $CO^2$ with Eastern bituminous coal and above 13 per cent. with anthracite. Get a candle or oil torch and inspect the walls of your boiler settings, locating and marking all cracks or openings at which the flame is pulled inward by the draught. Cases have been known where the total area of cracks has been greater than the area of a wide open fire door. Firemen know that if they leave the fire doors open all the time they cannot keep up steam, but they do not realize that cracked settings may do as much harm as open fire doors. If you can manage it, get these cracks stopped up with strips of cotton waste dipped in fire clay. Do it yourself if necessary, driving the waste tight into the cracks. After all leaks have been stopped on one boiler try flue gas analysis again and you may find that you have reached your 12 or 13 per cent. If you are still below 12 per cent. you must determine by means of your draught gauge the differential pressure through your fuel bed. Using the gauge to maintain the same differential, which really means the same thickness of fire bed, try reducing the draught intensity by closing down on the damper or reducing the ash pit pressure if forced draught is used. As the draught is reduced the stack gases should be analyzed and the $CO^2$ readings plotted on a chart. By such a systematic method of combining the results of analyses with draught readings the proper air supply for a certain fuel bed thickness can be determined and

the intensity of draught can be increased or decreased as the fire conditions change, these changes being shown by changes in the draught gauge reading. Care should be used in taking these observations and gas samples that fire conditions are normal, as samples taken from a broken or an uneven fuel bed, or one freshly coaled, will show analyses very different from those taken under average conditions, and may prove to be misleading.

You must realize fully the importance of systematic flue gas analysis work if you are to succeed in improving the efficiency of a boiler plant, for it is the only positive method of determining furnace conditions. It is certainly true that some practical engineers and firemen, who do not even know what $CO^2$ means, can and do get wonderful efficiency out of boilers, but these men know by long experience what draught is proper for a certain fuel bed thickness; they know how to fire their fuel to best advantage and how to keep their fuel bed clean and even, and such men as these are rare, and they are seldom found in firerooms working for low wages.

If you have succeeded in getting your boilers clean, air leaks stopped and proper draught regulation you will then have to take up your hardest job, that of getting the firemen to properly handle their fires. I could talk all evening on the troubles you will have, for there is no harder job I know of than to break an old fireman of bad habits, but for the sake of those here who have no idea of ever becoming combustion engineers and those who have already been scared out of any such idea by the prospect of shoveling coal and caulking boiler settings, I will simply give you an outline of the most common faults and their remedies.

(*a*) Coaling all doors of a furnace at one time. Alternate doors should be fired, with half the firing interval between doors. This applies to bituminous fuels only.

(*b*) Coaling heavily. Only a small quantity of coal should be fired at one time, just enough to lightly spread over half the grate. This is one of the most common faults.

(*c*) Tearing the fire with the blade of the hoe, in leveling the fire. This is a bad fault, as good coal is mixed with the ash, and clinker results.

(*d*) Tearing the fire with the slice bar. The bar should be only slightly lifted so as to free the grate of clinker. The bar should be used as little as possible, in most cases only when the ash pit becomes dull or the steam pressure drops.

(*e*) Opening wide the dampers when the pressure begins to drop and leaving them open. This will pull excess air through the fire and cause a further drop in pressure. The use of a slice bar and reducing the rate of feeding of water to the boiler at this time will generally bring the pressure back to normal.

(*f*) Improper feed water regulation. The feed water control valve should never be wide open or tight shut, but should be gradually opened up or throttled down.

(*g*) Waste of good coke in the ash, due either to improper slicing or careless cleaning of the fires.

(*h*) Careless cleaning of fires, resulting in loss of good fuel, or stoppage of part of the grate, which means uneven distribution to the fuel bed.

(*i*) Keeping furnace doors open so long as to admit an excessive amount of cold air. Due to carelessness or too much working of fires.

(*j*) Uneven fuel bed, due to carelessness or intent. Holes cause loss due to excess air.

These faults can only be corrected by careful supervision of the firemen, and by replacing those found to be consistently stupid or careless by men who, even if green at first, will do as they are told.

While carrying on the above work look out for water and steam leaks in the boiler room, and have them stopped as soon as located. Leaky blow-off cocks are often a cause of loss, and even small steam leaks should not be neglected.

One very important step you should lose no time in taking is a determination of the exact quality of the fuel the plant is using. If there is a chemist at the plant, get in touch with him and learn how the coal has been analyzing, also its B. T. U. value and the fusing point of its ash, if possible. If there is no chemist and the plant has been buying coal only on the coal dealer's good reputation, you are probably getting what other people will not take and you should make every effort to get a sample analyzed as soon as possible. Many plants are paying for 14,000 B. T. U. coal and getting 13,000 or less, because they have no way of testing it and the coal men know it. You may be able to save 10 per cent. of the fuel bill at once by changing the grade of coal or by forcing the dealer to deliver what you are paying for. If you find the ash contains a lot of carbon, get after your firemen and make them stop pulling out good coke when cleaning, and it may also pay you to have a sample from the ash pile analyzed, as there have been many cases where refuse piles have given up as high as 40 per cent. of good fuel when picked over by hand.

You may be surprised that I have not suggested running boiler tests or even mentioned them, but I have not done so for several reasons. Tests made on individual boilers are of very great value in determining the relative value of different grades of fuel, of different types of boilers, special furnaces or of other special boiler equipment or for scientific investigations, but they are of very doubtful value in determining the commercial, every

day dollars and cents operating efficiency of a plant. When a test is to be run everything is put in good physical condition, and the man who is doing the firing knows he is being watched and does his best, while this same man may on his regular shift be lazy and careless. It is the practice in some plants to run tests at certain intervals and base their estimates of boiler efficiency on the results of these tests. I consider this very bad practice and know of several plants which are in reality operating at very low efficiency, but their engineers cannot be made to realize it because good results were obtained on boiler tests. There is another objection to boiler tests in your case, which is that they cost money and usually interfere with the operation of the plant, to some extent. If you are starting in to improve conditions in a plant it is better to make as good a showing as possible without spending any money except for the needed repairs already indicated. If you can show the boss that your preliminary work has already begun to reduce his coal bills, he will be quite likely to listen when you come to him with suggestions for the purchase of new equipment, but if you start in by asking him to spend a few thousand in the power plant, you will find him a poor listener, and you may have to start in again somewhere else. Get all you can in the way of improved economy out of your present boiler equipment, then go after the parts of the plant where power is used in a manner which will be briefly outlined, then after you are sure you have made the most of the equipment you have you will be ready to suggest changes and improvements, and will, I hope, have already saved so much for the plant that the boss will be ready to make the changes you suggest. If, however, you spend a lot of money on new boiler equipment and then save so much power in the plant that a large part of the new boiler equipment is idle, you are likely to be asked why you put the cart before the horse, as few concerns like to see money tied up in idle equipment.

If you believe you are now getting all you can from your boilers you can go after the departments which use the steam you are making. Probably the best place to start is in the engine room. It is assumed that you are heating your feed water to 212° with exhaust steam, but you probably will find excess steam escaping to the atmosphere. Most of this should be used in the heating system during the winter months, but in summer it is wasted, and it is possible that it may be used for heating water or in some factory process, taking the place of live steam. The exhaust steam turbine is now being extensively used, and if waste exhaust can be collected in sufficient quantities such a machine can be installed to good advantage. The utilization of waste heat is an important problem in many plants, but one which requires careful study, and live steam wastes should be reduced to a minimum

before it is worked out, for the more you reduce steam consumption the less exhaust you will have to make use of.

Make an examination of all live steam lines and get all leaky valves and pipe joints made tight and all bare pipe covered as quickly as possible. This is ordinary repair work, which should not have been neglected, and there should be no trouble in getting it done. Make it your business to inspect all steam lines at frequent intervals and keep the leaks stopped. If yours is an average plant you will be surprised at the fuel saved by stopping these losses. Locate all steam traps in the system and temporarily disconnect their discharge pipes, and see that they are operating properly and are not leaking. If they discharge back to the heater or boilers the engineer may say it makes no difference if they do leak, but he is wrong, unless you have not sufficient exhaust steam to heat feed water to 212°, an unusual condition. Inspect traps at frequent intervals and see that they are kept tight. A leaky trap may be wasting more steam than is used by a large engine.

The operating engineer can generally be depended on to keep his machinery in good external mechanical condition and his engine and steam pump valves properly adjusted, but it will pay you to look into the question of proper lubrication of internal surfaces and bearings, especially the latter. Many operating engineers prefer grease to oil, it is less sloppy in the engine room, and many kinds reduce the cost of lubricants. What you have to determine is the relation between the reduction in cost of lubricants and the increase in cost of fuel required to overcome the greater bearing friction, and decide what lubricant is most economical for use in the plant.

Because the machinery is in good external mechanical condition and runs as quietly as clockwork is no guarantee that it is efficient and economical. It is the operating engineer's business to keep the machinery in service; it is yours to see that it uses a minimum amount of steam in doing the work, for you are the money-saver of the steam plant and steam costs money. Valves of most reciprocating engines leak more or less, as do piston rings, and it is surprising how little attention operating engineers give to the keeping of internal parts steam tight. By blocking an engine or pump on centre and using indicator cocks or drains as test pipes you can easily determine if valves or rings leak, and if such is the case and the leak is serious it will be advisable for you to let this waste steam condense in a barrel of cold water and determine by actual weight the amount of steam lost through leakage. If you know the loss and put it into dollars you can determine how much you can afford to spend on repairs, and prove to the boss that it will pay to make them. The water ends of steam pumps

seldom receive proper attention, valves and seats are often allowed to wear until they leak so badly that the pump will not do its work before they are faced up. It seldom pays to let the slip in a pump exceed 10 per cent., as the saving in steam will soon pay for the cost of overhauling it.

If your plant operates condensing units see that the vacuum is kept at the most economical point at all times, and don't trust a vacuum gauge, get a mercury column and barometer if possible.

If the factory uses live steam for any manufacturing processes, try to determine the amount of heat which should be theoretically required to do the work and calculate the amount of steam required. If you can get a steam meter use it to determine how much more than this amount is actually being used, and find the reason for this excess consumption. If you have no meter you can only keep your eye on the people who use the steam and try to prevent their wasting it. People in one department don't worry much about wasting the product of another department, especially steam or power, and you will have to watch for waste all along the line.

After you have cut out all steam leaks and steam wastes you still have, in the average industrial plant, a great opportunity for power economy in the reduction of friction losses due to operation or idle or underloaded shafting and machinery. This problem, however, is one which involves careful study, as it will mean changes in equipment and therefore the expenditure of money, and as no two problems will be alike, it is impossible to give even an outline of what might be accomplished.

We will assume that you have now covered all parts of the plant and have stopped all wastes and saved several thousand dollars a year, and are satisfied that you cannot do any better with your present equipment, but you have had enough experience to feel confident that if you could change your furnaces, or install stokers and coal handling machinery, or possibly put in a new condensing unit, you could effect a great enough saving to pay a handsome return on the investment. You have gained the confidence of the boss by having "made good" and he is now paying you somewhere between $75 and $500 a month, depending on his nature and the depth of his gratitude to you, also largely on what he thinks is the least he can pay you and keep you satisfied. So far you have saved him a lot, have cost him little and have not asked him to spend any money on new equipment. You probably think that when you come to him with a proposition of spending $20,000 to save $5000 a year that he will jump at the chance. You may have worked nights and holidays on this idea of yours and you will probably feel sore and hurt when he turns you down, as he is very likely to do. You must remember, however, that

$20,000 is a large amount of money and that he is responsible for its proper use, and he wants to be very sure that he will get back on it all you say he will before he invests it in his power plant. If you know what your present equipment is doing and that it is the best it can be made to do, and that the new equipment will positively bring about the saving you have estimated, then go back at him with as brief and strong a written argument as you can make and he will probably reconsider and give you what you ask for. But don't be too enthusiastic and over estimate, and learn when it is too late that your figures were wrong, for you will be surely called on to account for every dollar that has been spent. You cannot afford to be overcautious, or you will never get very far, but you can and should be fairly conservative and not let your enthusiasm get the better of your judgment.

# The Towne Scientific School Journal

OF THE

## University of Pennsylvania

(WHITNEY MAGAZINE)

Published Quarterly by The Undergraduates of The Towne Scientific School

Subscription . . 25 Cents Per Copy, $1.00 Per Year

Entered as second-class matter Nov. 14th, 1914, at the Post Office at Philadelphia, Pa., under the act of March 3, 1879

Advertising Rates will be furnished upon application to the Business Manager.

---

Office Hours—1-2 P. M. Room 204, Engineering Building, 34th and Locust Streets

---




---

## EDITORIAL

**Chapel.**

At the request of the undergraduates, chapel attendance has again been made compulsory. It is a far reaching change, this, in the conduct of college affairs; and it is natural in this as in any change that there should be some friction in the readjustment and much misunderstanding of its true purpose. Yet one cannot help feeling, after a quiet study of the whole situation, that the new arrangement will prove a milestone in the history of undergraduate life.

Pennsylvania has been, in the past, too much of a university and too little of a college. There is no question about that.

We have had too little college life. We have had too little association with one another as Pennsylvania men; too much as members of a particular school of Pennsylvania. Indeed, we have gone so far in this unconscious segregation that we have developed real and very differing types of men. Here, we say, is a distinctly "Wharton" man, here a man with the earmarks of an Arts course; but where is "The Pennsylvania Man"? We vote as Engineers or Architects, again forgetting, in our class pride, that there may be a much larger issue. And so we narrow ourselves, and become a loose group of units rather than a unified group of undergraduates. Now, there is nothing under the sun so efficacious in bringing about a real amalgamation, a real college point of view, as a general class gathering once or twice a week. The commons-system at Harvard is good; the class dormitory system at Yale is better, in achieving the same end. Pennsylvania's conditions do not as yet admit of either of these means; but regular, enforced class meetings will go far toward the accomplishment of the idea. Surely it is no hardship to meet our fellow-students from other departments, to forget the differences of curriculum that separate us, in a general discussion of the welfare of our college.

There is another point, too, which must not be lost sight of. In a general way we agree with the poet who says that this world is too much with us; we know that too much stress is laid nowadays on the material, too little on the spiritual side of things. But we can't remedy it. How can we get quiet, we say, and take account of our spiritual stock, when we are rushing madly up through life, two steps at a time? Well, isn't it possible that this half hour at chapel, with its Scripture reading and prayer, may furnish just the addition needed to finish the education of a complete college man? We educate the physical and mental—why object to the spiritual?

Of course there are complaints—the hour is bad, the service cannot be heard, and many more. But, after all, these are matters that can be remedied with time. At least agree that the idea is good and much ought to come of the innovation.

**Technical Periodicals.**

We all at least think how beneficial and delightful it would be if we could subscribe to three, four or even more of the current technical magazines dealing with scientific subjects in general or with the particularized branch of Engineering or Architecture that we intend to follow for our life's work

But is it not more than a pleasant luxury? Is it not a duty we owe to ourselves? Only a few of us can subscribe to even the one paper in which we are particularly interested, but all of

us can take advantage of the opportunity of access to all the current periodicals offered to us through the University Library and its departmental branches. And let us not be narrow in the scope of our reading, whether we subscribe to all we think we care to read, or to none at all. The branches of Engineering are very closely allied and Architecture is but a first cousin. We shall all have to work together in the practice of any of the various professions that we are now qualifying ourselves to follow, so let us start now to acquaint ourselves with the problems of our future business and professional associates.

Architects, we are equal partners with the Engineers in the publication of this journal. Let's support it!

If you have not subscribed, mend your ways and part with 50 cents and have the next two numbers sent to you.

If you are a subscriber, urge some one else to subscribe.

If you can't subscribe, swollow your medicine like a man and don't take advantage of the journal or the supply store by reading the copies and then putting them back on the counter.

It's your paper, not the editor's.

Criticise, and even find fault if necessary, but do it in good faith.

Make your paper worth the work that is put into it. To do this, do your share! Subscribe, then if necessary criticise!

---

## COMMUNICATION

To the Editor of the TOWNE SCIENTIFIC SCHOOL JOURNAL.

DEAR SIR: Success! That, I think, is the verdict of the Architects who saw the Engineers' show.

"Where there's a will there's a way" was proved conclusively by the actors, but I think it was proved with even more satisfaction by the success of the show as represented by the enthusiastic audiences which attended the two performances of the show. The "will," coming as it did only a short month ago I am sure that all the Architects would join me in giving hearty congratulations to the committees in charge and to the other men who did the thousand and one things which have to be done in such an undertaking, upon the manner in which they found the "way."

The Architectural Department and its many friends deeply regret the unfortunate turn of circumstances which prevents the production of their thirteenth annual show and hope that another year will bring forth the too long dormant but re-

nowned histrionic ability which always lies hidden in the department.

A Towne Scientific School show?

Why not?

I think the Architects can with justice take to themselves at least a small portion of the credit for the success of this, the first Engineers' show, because of the stage and part of the scenery which they were glad to donate. Let's think about uniting forces in our dramatic efforts, as we have done in our publications.

Each department has shown the ability to put over a good show. Would not the joint production be greater than either could produce alone? And all of this with no loss to either participant and with much less sacrifice to the work of the few individuals who have to run the show.

There is nothing that would do as much towards making us one in spirit as we are in name. We have to work together in the practice of our professions; let's work together now and know each other better.

It's possible!

A Towne Scientific School show.

Think of the possibilities!

(Signed) SENIOR ARCHITECT.


**Louis C. Madeira, 3d, '14** M. E., and Miss Maris L. Welsh, of Chestnut Hill, were married on December 11th.

**F. F. Boettcher, '14** E. E., has taken a position with Consolidated Gas Company at Long Branch, N. J.

**P. C. Gunion, '14** Ch. E., is with the By-product Coal Company department of the Philadelphia Suburban Gas and Electric Company. His address is care of Y. M. C. A., Chester, Pa.

**L. M. Hansen,** Ch. E. **'13,** has a position with the engineer of tests of the Santa Fe Railroad system.

**Herbert Church, '14** M. E., spent part of the summer in Europe until forced to return on account of the war.

**M. Cossacks,** M. E. **'13,** spent the summer in Europe with his family and is now working with the Liquid Carbonic Company, Chicago, Ill.

**G. L. Knox,** M. E. **'13,** is with Munoz & Munoz, consulting engineers, Los Angeles, Cal. Both of the Messrs. Munoz are graduates of the Towne Scientific School.

**W. S. Landis,** Ch. E. **'14,** has a position with the Westinghouse Lamp Company, Bloomfield, N. J. **Marbaker,** Ch. **'10,** Ph. D. **'14,** and **Kaufman,** E. E. **'12,** are also with this company.

**D. J. Lehman,** Ch. E. **'14,** is with the David Berg Distilling Company, of this city.

**Morgan Parsons,** E. E. **'14,** has taken a position with Stone and Webster Company, construction engineers, Boston, Mass.

**Spencer Roberts,** E. E. **'14,** is with William McClellan, consulting engineer, New York City. William McClellan is also a graduate of Pennsylvania.

**F. K. Rowe,** E. E. **'14,** has a position with the American Telephone and Telegraph Company. He is in the standardizing department, and located in New York City.

**R. H. Smith,** E. E. **'13,** is still with the Western Electric Company, Chicago, Ill.

**William F. Wade,** E. E. **'14,** was working for Day & Zimmerman Company, of Philadelphia, and is at present with the Penn Central Light and Power Company, Altoona, Pa.

**E. L. Webster,** M. E. **'14,** is in the Philadelphia offices of the Coatesville Boiler Company.

A daughter was born to **Mr.** and **Mrs. H. B. Price, Jr., '11,** of Stonega, Va., on November 9th.

**Harry Sternfeld,** Arch. **'11,** is now professor of design at the Carnegie Institute of Technology.

**William J. H. Hough,** Arch. **'11,** is studying in Rome, having won the Roman prize last year.

**R. L. Humphrey,** C. E. **'91,** was recently elected to the Presidency of the Philadelphia Association of Members of the American Society of Civil Engineers, succeeding Mr. G. S. Webster, B. S. '75, Sc. D. '10.

**Henry Worth Thornton,** B. S. **'94,** whose appointment about a year ago as General Manager of the Great Eastern Railway Company, one of the leading railway companies in England, attracted much attention, reports encouraging progress in measures for betterment inaugurated under his direction. Mr. Thornton was formerly General Superintendent of the Long Island Railroad.

**J. P. J. Williams,** B. S. **'95,** C. E. **'08,** contributed an interesting article on "Computing Maximum Bridge Stresses by Maximum-Moment Table" to the Engineering News of October 1, 1914. The general scheme proposed by Mr. Williams, and its application to a wide range of conditions, contains some features of distinct novelty, and effects a considerable saving of time and labor in connection with such computations.

**J. P. Baker, Jr.,** B. S. in C. E. **'05,** Assistant Supervisor on the Middle Division of the Pennsylvania Railroad, was recently awarded a prize of $200 for the maintenance of the best line and surface on a Main Line Superintendents' Division between New York and Pittsburgh and Philadelphia and Washington.

**Walter Samans,** M. E. **'05,** has been quarantined for a long time from scarlet fever along with his wife and two children. One of the children, a girl aged four, died on November 7th. Just previous to this, on October 18th, a little boy was added to the family, who is now doing well.

**H. S. Van Scoyoc,** B. S. in C. E. **'07,** formerly Inspecting Engineer of the Canada Cement Company, Ltd., Montreal, P. Q., has been appointed Chief Engineer of the Toronto-Hamilton Commission, which is to build a new highway between Toronto and Hamilton, Ont.


"WHERE THERE'S A WILL, THERE'S A WAY."

On Friday and Saturday evenings, December 18th and 19th, the combined efforts of the members of the Whitney and Civil Engineering Societies as Thespians were exhibited to maximum advantage before capacity houses. The show, a two-act musical comedy, "Where There's a Will, There's a Way," afforded many opportunities to the cast and chorus for a display of ability and grace that utterly belied the theory so generally accepted on the campus that the Engineers were merely "grinding automatons with slide rules."

The plot of the show carried a handsome and popular Senior in the "Brown Scientific School," and on the threshold of graduation, through many snares and pitfalls. In his final triumph he achieved success and carried with him his degree and a little more—the heart and hand of fair Grace, the daughter of Professor Elliston, who had sought to deprive him of both on the ground of frivolous incompetency.

The play, as well as the lyrics, was the work of William H. Jess, M. E. '15, and the music, which showed the fairy touch of budding genius, was composed by Wesley B. Tourtellotte, M. E. '15. No effort was spared by the men on other commissions, under the chairmanship of Horace Butler, E. E. '15, to augment in some small way the work of these two artists. Especially noticeable in the work of the cast and chorus was the painstaking care and untiring effort put forth by Coleman Sellers, 3d, M. E. '15; J. B. McCall, Jr., E. E. '17; Charles R. Nalle, C. E. '15, and James C. Patterson, M. E. '15, on the training of the cast and choruses.

In the cast "our hero," Raymond Fulmer, was well taken by R. Z. Zimmerman, M. E. '16, whose interpretation of the rather difficult dual personality of scientific business man and one who "speaks the language of the heart so well" was clever.

The part of the heroine, Grace, as filled by Warren D. Fuller, C. E. '15, was "all that the name implies" when the feminine characteristic was considered. The little gestures of the girl, and the small actions, so invariably absent in amateur female impersonators, were cleverly brought out, displaying a keen perception and a deep study of the fair sex.

Dr. Silvanius Silas Sheen, portrayed by John V. Hoey, C. E. '16, was delightfully frothy and refreshing. The "Coo-oo" song firmly fixed him in the minds and hearts of the audience, and his every entry thereafter brought its appreciative reception.

Clayton McMichael, E. E. '17, as Grace's father, Professor Elliston, presented as finished a piece of acting as was ever witnessed on the campus, his transition from the stern, cold man of affairs to the lovable "good fellow," as admitted in his song, "A Very Human Man," was brilliant.

"Jim," the Bert Williams of the show, as interpreted by Stanley Levy, E. E. '16, was very droll and his song "Inspiration" brought rounds of well-merited applause.

Olney Jones, M. E. '16, as "Helen" was most alluring in "her" charms, and no one really cast any recriminations on the professor for his infatuation.

One can still hear ringing in his ears the familiar line of Charles West, "Don't call me Charles!" This role, probably the most difficult of the whole cast to fill with merit, "feeder" to the "star," was ably filled by Samuel W. Marshall, M. E. '15, as was also the role of the worldly wise promoter, Thaddeus Fleecer, by Louis Wisnew, M. E. '16.

The dancing chorus, composed of four dashing "blondes" and their dance partners, furnished a truly meritable exhibition of the art terpsichorean, especially in the songs "New York Town" and "In a Garden Fair." The lilting dance song, "The Waltz Dream," gave opportunity to James C. Patterson and his glee chorus to display their mastery of harmony, as well as the dancing belles to repeat previous successes.

A great meed of praise is due the orchestra, whose untiring work made possible much of the success of the chorus.

In addition it may be remarked in passing that a new course has been instituted, that of "theatrical engineering." It involves a thorough knowledge of frame structures, with actual plans and shop work thereon; scenic draughting, with an experimental laboratory, including painting in colors, decorative interiors and a supplementary course in illumination, involving the theory of limitations of rheostatic voltage control.

In conclusion the general consensus of opinion is that the first annual production of the Engineers was an unqualified success from every viewpoint, and the hope is expressed that though "Where There's a Will, There's a Way" was quite near the

zenith of amateur production, the final curtain of next year's show may fall on an even more perfect exhibition of skill and ability.

EDWARD A. MILLAR, JR., E. E. '15.

## THE CAST

Grace Elliston ..................... W. D. Fuller, C. E. '15
Charles West ..................... S. W. Marshall, M. E. '15
Raymond Fullmer ............... R. Z. Zimmerman, M. E. '16
Professor Elliston ................. C. McMichael, E. E. '17
Dr. Sylvanius Silas Sheen ................ J. Hoey, C. E. '16
Jim ................................ S. Levy, E. E. '16
Helen ............................ E. O. Jones, M. E. '16
Thaddeus Fleecer .................... L. Wisnew, M. E. '16

## DANCING CHORUS

| Girls. | Men. |
|---|---|
| G. W. Anderson, E. E. '15 | A. F. Leopold, M. E. '15 |
| W. B. Black, M. E. '16 | E. H. Scherer, M. E. '16 |
| F. A. Epps, M. E. '16 | C. F. Thompson, M. E. '15 |
| R. M. Gantert, E. E. '16 | C. G. Watson, M. E. '16 |

## GLEE CHORUS

| | |
|---|---|
| J. C. Patterson, M. E. '15 | A. A. Abrams, E. E. '16 |
| F. T. Holl, M. E. '15 | E. A. Shrader, Ch. E. '17 |
| R. D. Sappington, E. E. '15 | J. E. Dallas, C. E. '18 |
| R. P. Marshall, M. E. '16 | F. H. Baker, C. E. '18 |

## ORCHESTRA

S. P. Barnett, C. E. '16, Leader.
W. B. Tourtellotte, M. E. '15, Director.

| | |
|---|---|
| E. H. Bart, Ch. E. '15 | E. P. Morton, C. E. '17 |
| S. J. Levine, C. E. '15 | G. B. Heckel, Ch. E. '17 |
| J. Tavares, C. E. '16 | F. Heckel, Ch. E. '17 |
| M. C. Scott, Ch. E. '16 | P. A. Reichle, C. E. '17 |
| M. E. Seltzer, M. E. '16 | J. Heckel, C. E. '18 |
| J. S. Frankenfield, C. E. '16 | M. Price, M. E. '18 |

A. Kauffman, M. E. '18

## COMMITTEE

Horace Butler, E. E. '15 ......................... Chairman
Edward Hayes, C. E. '15 ......................... Treasurer
Coleman Sellers, 3d, M. E. '15 ................. Stage Director
J. B. McCall, Jr., E. E. '17 ..................... Cast Director
C. R. Nalle, C. E. '15 ............... Dancing Chorus Director
J. C. Patterson, M. E. '15 ............... Glee Chorus Leader

| | |
|---|---|
| D. Davis, Jr., C. E. '15 | Arrangements |
| W. S. Swingle, E. E. '15 | Publicity |
| E. A. Millar, Jr., E. E. '15 | Scenery |
| R. S. Ridge, C. E. '15 | Costumes |
| C. M. Doolittle, E. E. '15 | Stage and Lights |
| S. H. Widdecombe, C. E. | General Committee |
| J. B. Kirk, E. E. '15 | General Committee |
| G. A. Beckett, C. E. '15 | General Committee |

---

## ARCHITECTURE

The following men were elected to the Architectural Society at a recent meeting:

J. C. Burchinal, '15.
E. P. Finegan, '15.
J. M. Green, Jr., '16.
J. A. Thompson, Sp. '15.
J. B. Wooley, '16.
R. O. Yeager, '15.

---

## CHEMICAL ENGINEERING

The Priestley Chemical Club held its thirteenth annual Christmas play and smoker in the Harrison Laboratory, Friday, December 11th, at 8 o'clock. The title of the play was "Sherman Was Right; a Party in Three Drinks and a Chaser."

### THE CAST

| | |
|---|---|
| Pat, an Irish servant | J. P. E. Price, Ch. E. '15 |
| Marie, a German barmaid | G. C. Wheeler, Ch. E. '15 |
| Hans, a German innkeeper | William Whalen, Ch. E. '17 |
| Frederick, nephew of Hans | C. V. Smith, Ch. E. '15 |
| Johann, a village constable | R. J. O'Neill, Ch. E. '16 |
| Jack } B. S. in Ch. E. | F. R. Palmer, Ch. E. '15 |
| Harry } B. S. in Ch. E. | R. J. Frederick, Ch. E. '15 |
| Miss Helen Ray, an American girl | Wm. Zimmerman, Ch. E. '16 |
| Mrs. Alice Pennock, Helen's chaperon | K. De Rosay, Ch. E. '17 |
| Embryo Chemists | B. Stambler, Ch. E. '15<br>R. J. O'Neill, Ch. E. '16<br>J. P. E. Price, Ch. E. '15 |

Chorus of German villagers, a Co-ed, Mr. Wallace.

The play opened showing the interior of a German inn. The time was in August, 1914, immediately after the opening of the present European war. One sees at a glance that Pat is in love with Marie, who cares nothing for him, as she secretly admires Jack, a recent guest at the inn. Frederick, the wily villain,

appears and decides that Jack and Harry are in the way of his plans, so he tells Johann that they are not Americans, as they purport to be, but that they are English spies. Harry and Jack, on their way back to the States, arrive at this point, and meet Mrs. Pennock and Miss Ray. They intend to continue their trip in the morning, but find that all ports are closed because of the war.

The second act takes place a week later and shows that Jack and Harry have made the most of their time and have become very much infatuated with the two girls. Frederick steals some papers from the boys' room as evidence for Johann that they are really spies. Jack goes out and leaves Harry drinking with Hans. Harry induces Hans to sing for him, which he does very creditably, singing "I Want What I Want When I Want It." At the end of which Harry tries to sing a song, but he has had too much to drink and falls over in a stupor. He dreams of the good old days when he was studying quantitative analysis. The scene quickly changes to the interior of the balance room in the quantitative laboratory, showing three students and a co-ed at work (?).

The students sing several clever songs, scoring the various members of the faculty, chapel and other phases of the undergraduates' troubles. The second and third students give an Irish folk dance, which ends when one of them puts his foot through one of the balances, spoiling two weeks' work. The student whose work has been ruined decides that it is much easier to get the results from his slide rule than it is to do all the work over again, and he proceeds to do so, much to the surprise of the faculty scattered throughout the audience. Right here Mr. Wallace's head appears in the doorway of the balance room, put-

In the third act Jack shows Marie that he no longer cares for her, and the poor girl turns to Pat for solace. Johann obtains the papers from Frederick and attempts to arrest the two boys, but they prove to him that the so-called plans are nothing but Freshman drawings, and sure enough there is the old, familiar "See me Fry." Johann is very much put out and wreaks his vengeance on Frederick. Jack and Harry do the usual thing, and with the girls held firmly in their manly arms they wonder where Sherman got the material for his famous thesis, "War is h——."

---

## CIVIL ENGINEERING

Since the last issue of the "Towne Journal" the Civil Engineering Society has held two meetings, the president, Mr. Beckett, presiding in both instances.

At the November meeting the main topic of discussion related to plans whereby the two engineering societies could

amalgamate for a Christmas entertainment. Various suggestions were made, and a musical comedy was finally hit upon. With this idea in view, a committee was appointed to confer with members of the Whitney Society.

Owing to the fact that Alger, the treasurer-elect, did not return to college in the fall, it was necessary to elect some one to fill the vacancy. Dillingham, of the junior class, was the society's selection.

An illustrated lecture by Turner, of the Junior class, held the attention of the members. The talk had to deal with concrete road construction, and the numerous colored slides gave a very clear conception of all the phases of the work.

At the December meeting it was found necessary to fill still another vacancy in the officers of the society, made so by the resignation of Marburg, the vice president. Tighe was the successful candidate.

Plans were discussed for the annual dance, and again it was decided to hold the affair in conjunction with the Whitney Society, if satisfactory arrangements could be made.

For the second time within the past two years the society was addressed by H. H. Quimby, C. E., the chief of the Department of City Transit of the city of Philadelphia. His topic was the trunnion bascule bridge over the Schuylkill River at Passyunk avenue, and was very well illustrated with numerous slides. All the details were gone into and a very clear conception of the working of the bridge obtained. It was by far the best talk that the society has enjoyed since Mr. Quimby's last visit.

As usual, the Refreshment Committee had been busy, and the society did justice to everything that they had provided.

## WHITNEY ENGINEERING SOCIETY.

An enthusiastic meeting of the Whitney Engineering Society was held in the society rooms on Friday evening, November 19, 1914. After the business meeting the Sunshine Quartette gave half an hour of entertaining songs and sunshine. Mr. C. L. Bruff, Combustion Engineer of the U. G. I., then gave a short talk on *Power Plant Efficiency*. Then followed some "real movies," and then the inevitable "eats." The meeting was well attended and was thoroughly enjoyed by all present.

## JANUARY MEETING

Every one is looking forward to the joint meeting of the Whitney and Civil Societies, to be held in January. The talk of the evening will be of interest to both societies. Moving pic-

tures will be in order, and it is hoped that every one will turn out and make this meeting still more successful than the Freshman reception.

## ELECTRICAL ENGINEERING

The faculty of the Electrical Engineering Department have done a great deal for the Engineers' Show in supplying rheostats, wire and good will. We wish to thank them for their hearty co-operation.

---

Immediately after the Engineers' Show, on Friday and Saturday nights, December 18th and 19th, the audience was invited to watch, among many other things of interest, the corona effect on a high-tension transmission line. The 100,000 volt transformer was connected up for the purpose to a temporary line. The corona was very marked at 90,000 volts, and those of the audience who did not understand the phenomenon were at least impressed by the weird light.

Under the careful guidance of Doctor Pender and Professor Clewell, the Electrical Engineering Department has moved smoothly along its way, almost to the inevitable "mid-years." The fact that none of the "electricals" has been blown up or electrocuted is due in a large measure to the vigilance of the instructors in the laboratory. The last two months have not been lacking in occasional firework displays of a mild nature; but perhaps these, too, have their place in the realm of instruction.

---

Dr. Harold Pender, professor of electrical engineering, has recently been appointed advisory editor of the Electrical World, one of the foremost electrical publications in this country, and issued weekly by the McGraw Publishing Company, of New York city. Hereafter all technical articles will be submitted to Doctor Pender for approval before they appear in the columns of this journal.

---

During December Prof. Charles F. Scott, head of the electrical engineering department of the Sheffield Scientific School of Yale University, visited the engineering building and inspected the various electrical laboratories. Professor Scott was formerly consulting engineer of the Westinghouse Electric and Manufacturing Company. During the development of the Niagara Falls Power Company, the chief engineer, Coleman Sellers, who received the honorary degree of Doctor of Science from the University in 1899, became interested in Professor Scott, then a young man in the employ of the Westinghouse

Company. The Niagara Falls Power Company designed for a two-phase generating equipment, through the invention of Mr. Scott of two-phase-three-phase transformation, was able to employ the three-phase method of transmission between Niagara Falls and Buffalo. Professor Scott is a past president of the American Institute of Electrical Engineers and a member of the American Philosophical Society.

## PERSONAL

E. D. Harris, '16 M. E., and D. W. Hopkins received their varsity "P" for football at the Athletic Association directors' meeting on December 2, 1914. Also C. L. Borie, '17 Arch., and F. T. Tighe, '16 C. E., received their numerals. Those in the Towne Scientific School who were awarded the scrub team insignia are as follows: P. D. Brown, '15 M. E.; W. R. Clothier, '17 M. E.; E. C. Geyelin, '17 E. E.; R. B. Jones, '17 E. E.; W. R. Ringe, '17 E. E.; W. E. Robinson, '17 E. E.; H. Van Buskirk, '15 Arch., and H. R. Wharton, Jr., '17 M. E.

In cross-country, R. L. Colton, '16 Arch., was the only member of the team to receive the varsity letter.

G. S. Barker, '16 M. E., is captain of the gymnasium team, and H. B. Rex, '16 Arch., is manager.

C. R. Murphy, '16 Arch., was elected captain of the soccer team for next year. He has played a very consistent game this fall and has scored more goals than any one else on the team.

F. I. Marshall, '18 Arch., was elected president of the Freshman class. Marshall made the Freshman basketball team, but owing to the strenuous course of the Architectural Department was forced to retire from the game. He is the Freshman representative of the honor system of the department.

Kendall Masten, '15 Arch. Sp., is one of the fastest swimmers in college ranks and should help Coach Kistler's squad to be a serious contender for the championship this year.

## POWER HOUSE TRAGEDY

ONE ACT.

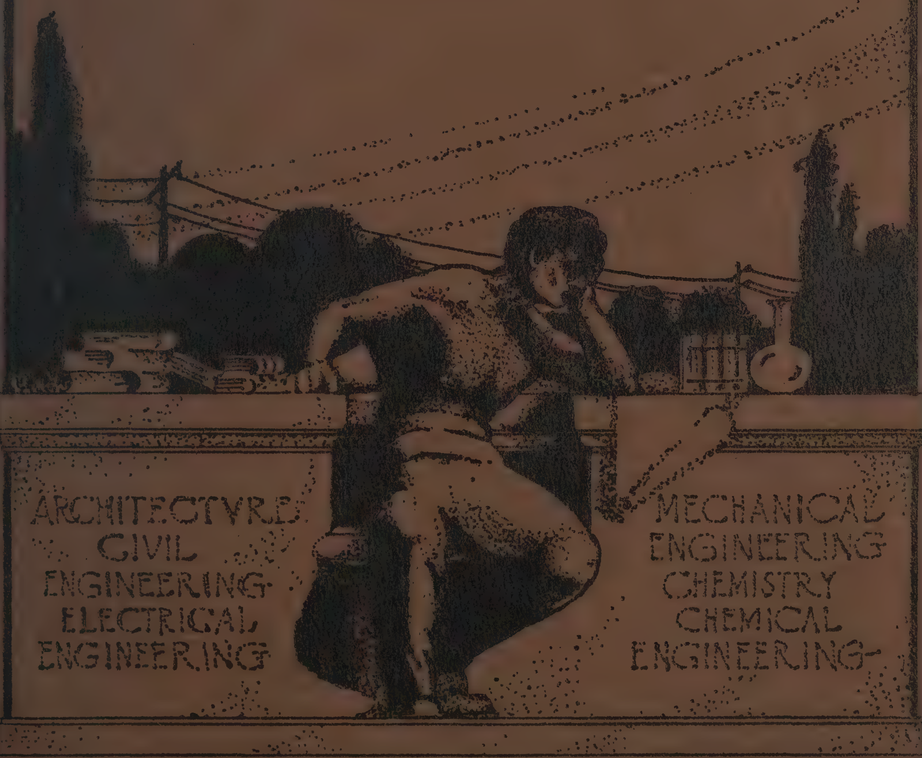
High tension
    Alternator;
Short circuit,
    Circuit breaker.
Couldn't stop,
    Held breaker.
Green flash!
    Undertaker.

JOHN C. WHITAKER, M. E. '16.

MARCH NUMBER

# THE TOWNE SCIENTIFIC SCHOOL JOURNAL

PUBLISHED BY THE UNDERGRADUATES




VNIVERSITY OF PENNSYLVANIA

# Towne Scientific School Journal

March, 1915

Published by the

UNDERGRADUATES OF THE

Towne Scientific School of the
University of Pennsylvania

Room 204, Engineering Building, U. of P., Philadelphia, Pa.

SUN PRINTING HOUSE, PUBLISHERS
PHILADELPHIA

# CONTENTS

## March, 1915

PLATE No. 2

PLATE No 1

PLATE No. 3

PLATE No. 4

The Towne Scientific School Journal

Vol. II MARCH, 1915 No. 3

# THE PREPARATION OF A SHEET ASPHALT PAVEMENT

C. S. Bird, C.E. '15.

History.

The asphalt pavement, as we know it in this country today, has been a gradual evolution from the hit-or-miss combination of coal tar, broken stone and coal ashes of fifty years ago, to the rationally proportioned mixtures of asphalt, sand and stone of modern practice. The first bituminous roadway laid on a public highway of which there is an authentic record was probably the asphalt macadam laid on the road between Bordeaux and Rouen in 1840. This was a mixture of asphalt rock and ordinary stone. In this country a short stretch of roadway in Prospect Park, Brooklyn, was laid in 1867, although sidewalks and cross-walks of this coal tar, stone, and coal ashes mixture had been used in Lock Haven, Pa., previous to 1866. This coal tar mixture gave comparative satisfaction as long as a good quality of tar could be obtained. A great objection to its use, however, was the fact that owing to the volatile oils carried in the coal tar it was necessary to close a street from thirty to sixty days after completion. For this and for other reasons search was made for a substitute for coal tar as a cementing material.

E. J. DeSmedt, who had experimented extensively with this in mind, laid a bituminous pavement in Newark, N. J., in 1870, with Trinidad asphalt as a cementing material. This is conceded to be the first asphalt pavement laid in the United States.

Shortly after, similar pavements were laid in Philadelphia and New York City. Until 1894 sheet asphalt pavements were laid on emperical lines without any definite recognition of what sand grading was necessary for success, why finely ground mineral matter should be added to the surface mixture, or of the relation of the asphaltic cement to the combination of sand and dust, known as the mineral aggregate. A vast area of sheet asphalt surface had been constructed in cities where the travel at that time was not excessive and where the greatest demands for stability were not made upon a surface of this type.

## GENERAL CONSIDERATIONS.

The present general rule for determining the percentage of bitumen, and the gradation of the binder in both the binder and the wearing courses have been evolved from numerous experiments, both laboratory and field. A discussion of this evolution would be too exhaustive for the limits of this paper, and, therefore, a few general statements only, covering the accepted practice today, will be made. This data was collected by the writer while employed as inspector in the asphalt division of the Philadelphia Bureau of Highways, and hence present practice in Philadelphia will be used as a model.

The first step in the paving of any street is the selection of the character of pavement. We will assume that for reasons which are foreign to this paper asphalt has been decided upon.

The first thing that the engineer does is to make a study of the traffic conditions, both present and future; then comes a determination of the final width and the possibility of car tracks. After that he considers the relative amount of shade that the street will have in summer, for on this depends, in part, the penetration to be fixed for the asphalt, and upon the penetration depends, to a greater degree than any other single element, the life of the finished pavement.

## REQUIREMENTS OBSERVED IN SELECTION OF CONSTITUENTS.

### THE AGGREGATE.

The essential requirements for an asphalt sand are that it shall be hard grained, moderately sharp and well graded, and comparatively free from loam. Owing to the difficulty of getting a continuous supply of uniformly graded sand, the limits of sizes of the particles are rather wide. The following table represents good practice:

| | | | | | |
|---|---|---|---|---|---|
| Portland cement or stone dust | passing | No. | 200 | sieve | —10-15% |
| sand | " | " | 80 | " | —18-36% |
| " | " | " | 40 | " | —20-50% |
| " | " | " | 10 | " | — 8-25% |
| " | " | " | 4 | " | up to 10% |

(Sieves to be used in the order named.)

Until recently, the importance of filler—that is, particles finer than No. 200 mesh—was overlooked, but it is now generally conceded that a large part of the failures of early sheet asphalt pavements may be attributed to the lack of filler in sufficient quantities. It is customary to supplement the filler naturally present in the sand with stone dust, so as to bring the total filler within the required limits.

The stone used for binder should be clean, hard and

durable, the maximum size being such that it will pass a one-inch ring.

The Asphalt.

There are various kinds of asphalt used, the physical properties in some being widely different; in others the difference is more apparent than real.

Trinidad was possibly the first used in this country. In its crude state it contains a large proportion of water, organic and mineral matter, and even after refining the percentage of bitumen (which governs the quantity of asphaltic cement used in the mixture) is taken as 56%. Other asphalts commonly used, with the general accepted percentage of bitumen (in the refined state), are: Bermudez, 96%; California and Mexican, 100%. The refined asphalt, however, is very rarely suitable for use in the pavement. To obtain the required consistency, or "penetration," as it is technically called, it is necessary to "oil" it or add a flux.

The Flux.

The flux is a parafine, a semi-asphaltic or asphaltic residue, whose office is to soften the asphalt with which it is mixed. Translating the chemico-physical requirements, a good flux may be said to be one which will make a complete solution of the asphalt to which it is added, and be but very slightly volatile under extended heating (four to five hours) at 325 degrees Fahr. The amount of flux to be added depends on the penetration required, the kind of flux and asphalt, and the present penetration. The penetration is determined by a physical test and is probably the most important single test of the asphaltic cement, technically A. C., as the mixture of refined asphalt (R. A) and flux is known. It is made at least once a day, oftener if required, at the plant.

The Penetrometer.

The apparatus used, a New York Testing Laboratory penetrometer, or a Dow penetration apparatus, consists of a frame supporting a 200-gram weight, in which a No. 2 sewing needle is inserted, and a dial for measuring the depth with which the needle penetrates the sample on release of clamp. The conditions under which the test is made, in addition to those mentioned, are as follows: The sample, in a 2½-inch ointment can, is tested under water at a temperature of 77 degrees Fahr. and must previously have been kept at this temperature, under water, for at least thirty minutes. The time allowed for the needle to sink is five seconds, measured with a metronome. The penetration is measured in hundredths of a centimeter, called points.

Determination of Proper Determination.

The determination of the proper penetration to be used in any pavement is a matter of considerable skill and experience. It depends, first of all, upon the asphalt to be used, and secondly upon the conditions outlined under the heading "General Considerations." Traffic conditions are characterized as heavy, medium and light, and the penetration ranges, to be specified, are very closely as given below. Assuming, for example, that Mexican asphalt is to be used, the penetration for a heavy traffic street would be between 50 and 54, medium traffic 55 to 59 and light traffic 60 to 64. The range of four points for all three classes is permitted because of the practical difficulties in the way of getting an exact penetration. At that practically all plant foremen complain that these limits are too narrow. If Bermudez asphalt is used, the penetration ranges are three to five points lower than for Mexican. California asphalt demands the same values as does Mexican.

Percentage of Bitumen.

The range in the percentage of bitumen desirable for best results is very narrow, as it lies between 10% and 11%.

For medium or light traffic streets, and with the higher penetrations, about 10.5% is specified, while for medium heavy and very heavy traffic, with the lower penetrations and the higher percentage of dust, 10.75% to 11.0% is used. For patching purposes 10.25% to 10.35% is found to give excellent results. These figures, both in regard to penetrations and percentage of bitumens, correspond fairly closely to the general practice in this part of the country, although they should not run exactly similar in all cases. The percentage of bitumen also varies somewhat with the climate, shade conditions and the grading and nature of the sand. Climate effects should also be given due regard in the selection of a suitable penetration.

The Plant.

A brief description of the actual mixing process may not be undesirable. General views of asphalt plants are shown on plates (1) and (2), (1) being a railroad or movable plant, (2) a fixed plant. Both attain the same results with slightly different arrangement of equipment.

The preparation of "top," or wearing surface, is as follows: The sand is shoveled into the cold sand elevators, well shown on plate (2). These dump into two sand drums, plate (2), which are heated, at this plant by a coal furnace underneath, in some other plants by an internal oil blast. The

drums are pitched slightly, and as they revolve at about 15 R. P. M., the sand is dried and heated to a temperature which should not exceed 400 degrees Fahr., but which frequently does. After passing through the drums the sand is raised by the hot sand elevators to a storage bin, holding from two to twenty or more loads, depending on the nature of the plant. A load is from five to seven "boxes," a box being the capacity of the apparatus in which the mixture is made. From here the sand flows by gravity, in quantities controlled by the operator, to the sand box (upper centre of plate 3) and is there weighed, or measured in some cases volumetrically, after which the proper weight of stone dust is added through a separate chute. While this process is going on the mixer man is filling his asphaltic cement bucket with the proper weight of asphaltic cement. The sand and dust are allowed to run into the mixing box (plate 4), mixed for a few seconds, and then the A. C. is poured into the box. To mix a box of top takes about one minute, the proper time being determined by the mixer man, who judges the mass while it is in motion. When he is satisfied it is dumped to a truck or wagon underneath the mixing platform (plate 3).

The A. C. is heated and fluxed in a tank known as a still (right centre of plate 2), being pumped here from tank cars. From the still the A. C. is usually fed by gravity to the mixing platform. For good results the temperature of the sand and A. C. before mixing should not exceed 375 degrees and 325 degrees Fahr., respectively, it being desirable to get the mixture on the street at a temperature between 280 degrees and 310 degrees Fahr. After some experience one is able to judge from the appearance of the mixture whether or not the desired end is being obtained, both in regard to temperature and proportions. Furthermore, the "pat" test, which is made five to ten times a day at the plant, and which consists of compressing a sample of hot top in a sheet of manila paper and noting the resultant stain, gives the experienced man an excellent line on whether the mixture is rich or lean from the appearance of the stain.

The essential features of a railroad plant may be said to consist in the fact that it is movable and more compact than a fixed plant. Further, for obvious reasons, both binder and wearing surface are mixed in the same mixing box, these being mixed separately at some plants.

The mixing of the binder in no way differs from the mixing of the top. In close binder, which is a mixture of A. C. sand and stone in the general proportions of one part of sand to four parts stone and from 5% to 8% bitumen, the require-

ments, in addition to temperature, are that just enough sand be used to coat the surface of the stone, and no more. It is an easy matter to specify the proportions of sand and stone, but to actually get the proper mixture requires constant vigilance and attention. Open binder, used for patching, consists of stone just coated with A. C., the percentage of bitumen ranging from 3% to 5%. In both open and close binder the stone should be such that it will pass an inch ring and in addition be well graded.

BITUMINOUS CONCRETE.

Of late years asphaltic concrete, which, as the name implies, is a mixture of bitumen, sand and stone, has come more and more into general use. It is particularly well suited for automobile traffic, and is distinctly not desirable for paving that will be subjected to heavy horse-drawn traffic, since the presence of stone on the surface gives full opportunity for the shoes of a horse to chip and crack the surface, thus leading to speedy disintegration. Such bituminous concrete can be laid for about 75% of the cost of sheet asphalt; it is much used in localities where a sheet asphalt pavement would be too great a burden on the taxpayer. Most of the generally used mixtures are patented, thus necessitating the payment of royalties. "Topeka" is an exception to this rule. A few of the more generally used mixtures are tabulated.

FILBERTINE.

| | |
|---|---|
| Stone, ¾-inch, hard crushed | 55 to 65% |
| Stone, coarse to fine | 35 to 45% |
| Limestone dust or Portland cement | 4 to 6% |
| Asphaltic cement, 60 to 80 penetration | 5 to 8% |

(Mixing temperature and conditions identical with that of sheet asphalt wearing surface previously described.)

WARRENITE.

Material passing a 1¼-inch screen, retained on No. 2 sieve, 40 to 60%.

Material passing a No. 2 sieve, retained on No. 4 sieve, 10 to 20%.

Material passing a No. 4 sieve, retained on No. 10 sieve, 10 to 5%.

Material passing a No. 10 sieve, retained on No. 30 sieve, 10 to 5%.

Material passing a No. 80 sieve, at least 25% of which will pass a No. 200 sieve, 10 to 5%. The balance to pass a No. 30 sieve and be retained on a No. 80 sieve. From 5 to 10% Warrenite cement to be used of 50 to 70 penetration. Mixed at 250 to 325 degrees Fahr.

Topeka.

This bituminous concrete differs from sheet asphalt in the following particulars: Clean, hard limestone or trap-rock chips which will pass a ½-inch screen and be retained on a No. 10 screen is added to the sand in quantities such that it will amount to 25% of the whole aggregate. Between 8 and 11% of bitumen, penetration 52 to 60.

References: All matter under heading "History" taken from Richardson's "The Modern Asphalt Pavement." All tables taken from Highway Bureau specifications.

---

# THE SCIENTIFIC DEPARTMENT IN ITS EARLY DAYS

Coleman Sellers, Jr., B.S. '73, M.S. '76.

About 1868 the University of Pennsylvania established in the College an alternative course leading to the degree of B.S. instead of the usual A.B. The curriculum differed but little from that of the classical course except that Latin and Greek were not required and an effort was made to furnish an equivalent amount in the modern languages, extra mathematics and history. The Trustees had in mind the establishment of a school or department of Science; but the totally inadequate building on Ninth street above Chestnut afforded no opportunity, and a real beginning was deferred until the completion of the new buildings in West Philadelphia.

As a matter of fact, most of the early candidates for the B.S. degree, especially those of '72 and '73, took the course because they were not prepared in Latin and Greek or because they did not wish to study those languages. In '73 there were only five students, as far as I know, who entered College with a definite purpose to follow engineering or science as a vocation.

The Class of '72 graduated 28 Bachelors of Arts and 3 Bachelors of Science; while among the graduates of '73 were 25 A.B.'s and 10 Bachelors of Science. Of the latter, four became lawyers, one a physician, two took up geology for a few years, two were mechanical engineers and one was a civil engineer—a tutor in mathematics, college professor and finally a clergyman.

Of the 33 non-graduates of '73, 17 were credited to the Arts and 16 to the Science course.

The college year of 1872 began in the new buildings, College Hall and what is now Logan Hall then housing the Medical School. With the beginning of the term the Department of Science was formally established, but it was not called the Towne Scientific School until 1875. The Department of Science had chairs of Chemistry, Mechanical, Civil and Mining Engineering. Of these the chemical course was the best manned and had the best equipment; a distinguished chemist gave it the prestige of his name and competent assistants were appointed. Laboratories for qualitative and quantitative analyses were provided and quite thoroughly equipped.

The Engineering courses had drafting rooms of a sort, but no apparatus. A physical laboratory was projected and something done towards the necessary apparatus, but it was not put into service that year, partly, I suppose, because the sudden death of Professor John F. Frazer threw the Department of Physics into confusion, and it was some months before a permanent successor was chosen.

Those of us who began our college life in the grimy, dingy, crowded Ninth Street building thought our new quarters very fine and were quite satisfied with the equipment, though not with all of the new members of the faculty.

As I compare those days of small beginnings with the magnificent completeness of the present Engineering Building, I wonder if the student of today realizes and appreciates the extraordinary opportunities which are his. In that first year we had no shops, no laboratories except the chemical, no library (except nominally), no apparatus and even no lockers. We had to go from room to room carrying overcoat, umbrella, overshoes, all of the books we should or might require during the day and anything else that the exigencies of the weather or our personal needs might indicate. It all looks very primitive now, and elementary, and yet we really thought we were hard worked and very fully occupied. The hours for the scientific students were long and home preparation was heavy. Perhaps that was partly the reason so many fell by the wayside. Seventy-seven, for instance, graduated 21 in Arts and 10 in Science, while among the non-graduates were 20 in Arts and 32 in Science. The faculty evidently did not intend that we should suffer any more than was unavoidable for our loss of Latin and Greek. In that formative period, the mechanical engineers-to-be fared the worst, as far as their specialty was concerned. We had some elementary mechanical drawing and floundered about in Weisbach's "Mechanics" under an incompetent teacher, who talked broken English and who could not teach the little he knew. There were compensations, however, such as Professor Peter Lesley's intensely interesting

talks on the "Geology of Pennsylvania," and there was intimate contact with certain fine men of the faculty whose personality was strong and impressive, and sometimes inspiring. This personal influence cannot be felt so powerfully when the student body is very large and direct intercourse with the department heads is impossible for most students. Moreover, while our specialty was chiefly conspicuous by its absence, we got an excellent general course of training, and in many branches which were certainly good for us, although they belonged to the cultural rather than the practical side of education. I must, of course, always regret the meager help the University was able to give me as an engineer, but I am grateful that I was able to get a training which undoubtedly was broadening and gave me a glimpse, at least, of many subjects which I was not likely to reach in my reading.

---

## "THE TOPAZ TULIP"

THIRTEENTH ANNUAL PRODUCTION OF THE ARCHITECTURAL SOCIETY.

GEORGE W. BAUMEISTER, Arch. '15.

Photos by Lewis. Drawings by Keally.

It is pretty universally conceded that troubles never come singly. It was, therefore, quite fitting that upon our return to school this year the cloud of a large disappointment should be accompanied by the announcement that there was to be no play. Early in the year came the news of the proposed alteration to the studio, which would make the play an impossibility. The regret of the new men who had heard from various sources of former plays was far overshadowed by that of the upper classmen, who realized what an important part they played in the development of the characteristic department spirit and Pennsylvania loyalty, and they viewed with keen regret what appeared to be the passing of a departmental institution.

Therefore, the exultation with which the fellows greeted Dr. Laird's subsequent announcement that the show had been made possible can better be imagined than described. What mattered it if we only had what seemed to be an absurdly short time; all the pent-up disappointment became transformed to joy and the first anxious efforts toward making the show a big success were clumsy in their futility and haste. But, under the capable management of Brad. Tazewell, the machinery of preparation was soon working smoothly and harmoniously, and "Grub Street" was reborn.

·1· GLEE CHORUS · · ·
·2· CARRÈRE · AND · REX · ·
·3· KLINE · AS · KATRINE ·

Year after year these productions have become more and more elaborate, and the work of preparation more and more intricate. "Better than ever before" is the everlasting aspiration, and "better than ever before" is the inevitable verdict. Public commendation and box-office receipts are evidences that it has achieved success.

"The Topaz Tulip" was the joint production of C. R. Murphy, '16, and G. B. Mayer, '16. It was selected in a competition with six other plays by a competent committee, who pronounced it one of the cleverest scenarios ever presented for the "architectural annual." It was particularly commendable for the timeliness of its subject (i. e., the evacuation of Dental Hall by the Dents and its subsequent triumphal occupation by the Architects), the opportunity provided for picturesque settings in the second act and its numerous amusing situations.

The story revolved about a search for the "Topaz Tulip." The eminent Professor de Bique, very emphatically from L'Ecole and very excitable, would give all "zat he possesses" for the wonderful "golden brown" color which is found only in "ze" Topaz Tulip. It would enable him to complete his chef d'œuvre and become recognized as one of the world's master painters.

Here an unkind Fate complicates a very laudatory search by decreeing that a certain Mr. Warren, described as a Pittsburgh plutocrat with a "monumental toothache," shall come to the Pennsylvania Dental School for treatment. Mr. Warren makes two very grave errors. The first is that he should mistake the new Architectural School for the Dental School simply because it happened to be located in a building labeled Dental Hall, and further because there happens to remain a relic of the previous occupants in the form of a dental chair, model 1823.

The second mistake is that he should rashly, in one of the hysterical moments of his spasmodic attacks of excruciating toothache, swear that he would endow a new building if only the object of his search, Dr. Molar, would relieve him of his agonizing pain without relieving him of his tooth. Enter now the little god of all trouble in the person of J. C. Burchinal, '15, alias Billy Burns, styled in the program as "a student now and then" (how fitting!). He decides to do the "relieving act" for Mr. Warren and bring "home the bacon," to the glorification of the Architectural School. So be it. He decides to impersonate the world-renowned Dr. Molar. His fellow-students are his assistants. How very contemptible to deceive a kind and credulous, but suffering old gentleman like Mr. Warren, whose usually keen sensibilities are temporarily dulled by his terrible toothache.

How mean! How despicable! So thought the lovely Miss Warren as she interrupted the consultation of the pseudo dentists (a scene which brought tears of laughter to many an eye in its ludicrous mummery). She recognized in one of the operators Dick Doolittle, an acquaintance whom she knows to be an architectural student. An exposure seems imminent and the million on wing. However, the situation is again saved by the infallible Billy Burns.

He exposes Dick as an imposter, frantically upbraids him as a scoundrel and rides rough shod over him as a "despicable cur who would stoop so low as to seek to palm himself off as a dentist."

Mr. Warren's faith in his solicitous friend returns in full measure, and when the "Doctor" prescribes the juice of a Topaz Tulip as the only permanent cure for his awful malady he persuades "Dr. Moler and his assistants" to go with him to Holland, the land of the Topaz Tulip.

And Dick, poor Dick, alone, and the only girl in the world for him off in Holland.

Fickle fate, but now a kind one, intervenes at this critical moment and saves the day.

Professor De Bique (whose unisyllabic surname suggests much, and whose various remarks seem very strangely familiar) discovers that the aspiration of his dreams, the "Topaz Tulip," grows in Holland. He employs the more than willing Dick to help him in his search and the day is saved.

The next scene brings us to Holland and opens upon three very despondent architectural students bewailing the unkind circumstance which landed them in Holland. The search for the Topaz Tulip has been as dull as it has been fruitless, and they are all about ready to give it up. A haunting dread of the "long, sloppy walk back to U. S. A. without overshoes" makes it imperative that the deception be continued and the terrible ennui endured. But necessity, in its proverbial maternalism, suggests to the fertile imagination of our chief conspirator a daring alternate. Dr. Molar must die, quietly but suddenly. And so in the midst of a frenzied fit brought on by the mention of the name of that terrible scoundrel Dick, the outraged "Doctor" passes away. His place in the world is taken by a chubby-faced Dutch boy, Vustenbourg von Schimmelpfennig (alias Billy Burns), whose sole ambition is to earn, or get otherwise, enough money to buy a one-way ticket in an ocean liner for Billy Burns, erstwhile Dr. Molar, and possibly his fellow-conspirators.

But when the irrepressible Professor De Bique finally locates the object of his search through his agent Dick the

heart of our versatile pretender is so touched (and his mind so apprehensive of immediate trouble) that he can no longer deceive his kindly employer, lays bare the whole vile plot and duly repents (thereby quite incidentally getting out from under). Mr. Warren is a "good sport," however, and agrees

Suckert as Mr. Warren

Burchinall as Dr. Molar

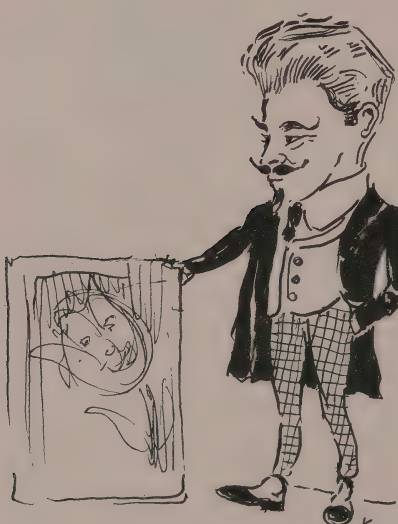
with the boys that his affliction was psychological, endows the long hoped for school, gives Dick the traditional "consent" and the curtain falls upon what is probably the last production of the Architectural Society in Grub Street Theatre.

In this year's cast there were only two fellows who took part in former architectural shows, and any one who saw Burchinal last year in "The Blue Smock" need not be told how immensely he contributed to the success of this year's production. Harold Calisch, in his impersonation of a hysterical Frenchman and his struggle with the English language, duplicated his wonderful success in his Freshman year as Count Boni de Bon Bon in "The Discounters." The others in the cast were called upon to make their initial appearance (some of them were eleventh-hour calls, too) and they responded nobly. Suckert, '16, as the self-made Pittsburgh plutocrat, was inimitable and made a big hit, which qualified him to join that "galaxy of stars" of architectural shows. The work of Frank Keally in support of Buchinal was especially commendable,

and the love scenes of Dick Doolittle (C. L. Borie, '17) and Helen Warren (J. C. Baily, '18) brought forth rounds of applause (although such trifles as the hang of Miss Warren's gowns and the angle of her hat elicited some criticism among the ladies in the audience). Of course, Clyde Payne could be depended upon to evoke much merriment as Mr. Schnitzel, a Stollwerksburger, and his daughter Katrine (Kline, '17) was certainly a lovely Dutch girl.

The specialties this year did more than their share toward making the play a success. Kayll, Lafferty and Easby, in "a little dark stuff," won great applause, while Rex and Carrére (introduced variously as Mr. and Mrs. Vermine Castile and Mr. and Mrs. Castle Vermin) scored heavily and were encored again and again.

The singing and dancing choruses were highly commendable and the music clever and melodious.



Calish as DeBique

Payne as Schnitzel

When it is borne in mind that everything that was done, from the carpentry and electrical work (by Van Alst, Tempest and innumerable assistants) to composing the music and painting the scenery (by Rabenold, Morrison, Bishop, Van Name, Dechant and others) was done by fellows now in the department, and that everything was done in so short a time and at such times as not to seriously interrupt the usual routine of

the work of the department, it can be seen that an institution has been developed and maintained which is absolutely free from professionalism or mercenary considerations, which give it its unique character.

Too much credit can never be given Ned Rogers for the intangible individuality which architectural plays have developed under his tutelage.

The show is now of the past, but the good that it does long survives it. The enthusiasm which it develops naturally finds its outlet in other college activities. The work of staging and preparation brings together fellows with common interests, and there is certain to be closer fellowship grow out of it.

The fact that the proceeds of this year's show are to be used in such a way as to show our love and respect for Messrs. Cret and Arnal, and our appreciation of them as teachers and as friends, is in itself sufficient to make all the toil and grind worth while!

---

## FLOW METERS

A. DE MACEDO, E.E. '16.

In the last few years the manufacturers of the United States have become aware of the fact that if they kept on producing without knowing exactly what it cost to make the power to run their plants the profits would soon be cut down to nothing. This great wave advocating economical manufacturing processes, which at present is sweeping over the United States, has brought about the development of the so-called flow meters.

The flow meter has developed along three main lines, namely, the V notch, the venturi tube and the pitot tube. The venturi meter was invented in 1887 by Mr. Clemence Herschel, a member of the American Society of Civil Engineers. This meter has proved very successful for metering the flow of water from large pumping stations of municipal waterworks. The venturi meter consists of a tube, made up of two frustums of conical tubes joined by a short cylindrical section called the throat, and of a recording and integrating device. The venturi tube is inserted in the pipe whose flow is to be metered and the pressures conveyed by small pipes to the register. When the water flows through the tube, which is usually of bronze and accurately machined, the pressure at the throat will be less than at the inlet, due to the increased velocity at the contracted portion. If the venturi tube is properly proportioned

the loss in pressure is nearly all regained at the outlet of the tube, due to the decrease in velocity. This can be easily proven by inserting pressure gauges at the points mentioned. This difference in pressure is conveyed by small pipes to a U tube containing mercury and causes the mercury to rise in one leg of the tube. This difference in levels indicates the loss of head caused by the restricted area of cross section at the throat and it is proportional to the velocity of the flow at that point. As the velocity of the fluid and the exact area of the throat are known, the amount of volume that will pass through the pipe can be easily calculated. If the installation is merely for testing purposes a manometer, which is practically a U tube filled with mercury and a scale suitably graduated, is used, and the pounds of steam per hour, gallons of water per minute or cubic feet of gas per minute, according to what is being measured, can be read directly. For permanent installations a time record or integrating device is connected with the venturi. The main part of this device is a modified U tube, partly filled with mercury, in one of which a float is placed. The difference in pressure causes the mercury to rise in one leg of the U tube, thus raising the float, which in turn actuates, by means of gears and cams, a pen or indicator marking on a dial the amount of fluid flowing. With this type of meter the amount of water evaporated in a battery of boilers is definitely known by the engineer in charge, and he can tell if he is burning his coal efficiently and in general operate his boilers more economically than if he merely depended on his own judgment.

Another form of meter which is gradually gaining ground is the "General Electric Flow Meter." This meter is based on the pitot tube, a very old instrument invented by Pitot and used for measuring velocities. In its simplest form it consists of a small tube having its lower end bent through 90° so that it may be placed in a stream with its open end turned directly against the current. The impact of the stream at the mouth of the tube causes a head, which is approximately $v^2 \, 2gh$, to be maintained above the free surface of the stream. The next step in its development was the Darcy gauge, which was made up of two pitot tubes having their mouths at right angles and connected to a manometer giving the velocity; however, this did not give very accurate results, as the velocity is not the same in all parts of a pipe cross section. Many experiments were tried to perfect this instrument, but it remained for Mr. Dodge, of the General Electric Company, to develop the present modified pitot tube known as the "G. E. nozzle plug." This modified pitot tube which, when placed in the pipe whose flow is to be measured, extends nearly across the diameter of the

pipe, consists of two tubes combined in one, each tube having a set of openings known as the trailing and leading sets, the former facing the flow and giving the mean dynamical pressure and the latter on the opposite side giving the mean static pressure. The nozzles are made in two forms known as the normal and high velocity nozzle plugs, the difference being that the high velocity plug has one of its trailing openings cut through to the leading side. This hole produces a counter pressure and thus reduces the total difference of pressure and consequently enables one to measure a larger flow.

To obtain the amount of fluid flowing through a pipe, a hole is drilled in the pipe at a place having at least a straight run of 10 pipe diameters. This hole is tapped and the nozzle plug is inserted. The plug is then connected with the meter by two pipes of small diameter, the pipes are connected by a cross-over valve and each has a valve of its own. The meter consists essentially of two vertical tubes connected across near the bottom by another tube, thus forming a U tube. This tube is half full of mercury and is balanced on knife edges. The difference in pressure in the nozzle plug is conveyed to the U tube by a flexible steel tubing. The difference in pressure causes the mercury to rise in the left cup and fall in the right hand cup until the difference is exactly balanced by the mercury columns. The displacement of the mercury throws the beam out of balance, and it therefore moves about the knife edges until balance is re-established. This movement is multiplied by levers connected to a pen which moves over a chart and records the flow. The charts consist of rolls of paper carried on a drum which is actuated by clockwork. The machines are made with and without pressure compensating devices by which pressure variations are corrected for automatically.

These meters have been successfully used to meter water, air and steam. At the present time many plants are installing this type of meter to get a line on their operating expenses and are realizing that a good metering system will rapidly detect and bring about the elimination of all sources of waste.

---

## RUST AND ITS CAUSES

Frank C. Hamilton, M.E. '16.

Since the dawn of history man has known and used iron, and since the dawn of history it has rotted and rusted and failed. Some years ago the rust problem became so important that a number of scientists took the matter up and made exhaustive studies of the subject.

Rust is a red-brown amorphus sesquioxide of iron which may or may not be hydrated. It occurs in progressive layers and the rate of decomposition increases progressively, at about one-half as much again in the second year as in the first.

The theory that rust is due entirely to the weather has been disproved, since for twenty-eight centuries an iron monument has stood through wind and rain at Delhi, India. Again, at Newbury, Mass., an iron chain bracing the piers of a suspension bridge stood for a hundred years without decay.

The rust resisting power of the iron in these two cases was due to the fact that it was pure and contained no foreign substances. All the non-metals except sulphur protect iron against rust, while many metals, such as nickel, chromium, etc., have the same effect. Manganese and graphite have the opposite effect, being the most active impurities in rust producing.

Three separate theories are advanced in an effort to explain the phenomenon of rusting:

(1) The Carbonic Acid Theory.
(2) The Hydrogen Peroxide Theory.
(3) The Electrolytic Theory.

The carbonic acid theory is that the carbonic acid in the air attacks the iron, forming a carbonate and hydrogen. The hydrogen unites with the oxygen of the air and decomposes the ferrous carbonate to ferric hydroxide or rust, while the original acid remains to go through the cycle again and produce more rust.

$$2\ Fe + 2\ H_2\ CO_3 = 2\ Fe\ CO_3 + 2\ H_2$$

$$2\ Fe\ CO_3 + 5\ H_2O + O = 2\ Fe\ (OH)_2 + 2\ H_2\ CO_3$$

According to the hydrogen peroxide theory the iron, oxygen and water form Fe O and hydrogen peroxide which then unite to form ferric hydroxide or rust, leaving an excess of $H_2\ O_2$ which attracts another quantity of iron and corrodes it.

$$Fe + O_2 + H_2O = Fe\ O + H_2\ O_2$$

$$2\ Fe\ O + H_2\ O_2 = Fe_2\ O_2\ (OH)_2 = Fe_2\ O_3 + H_2O$$

The electrolytic theory has more supporters than either of the others. It assumes that before iron can oxidize in a wet way it must first pass into solution as a ferrous iron. Whitney has made numerous experiments along this line and his results show that iron is soluble in pure water. He placed small pieces of pure iron in sterilized bottles of distilled water and sealed them up. These bottles were allowed to stand for weeks and the iron showed no visible change, but when the seals were broken and oxygen admitted rust immediately formed and deposited on the glass and on the metal. If a piece of iron be immersed in a solution containing hydrogenions the hydrogen acts as a metal. The iron goes into solution and the hydrogen

goes from its ionic or electrically charged condition to its atomic or gaseous condition. It is a well-known fact that solutions of ferrous salts oxidize rapidly in air to the ferric condition, or rust.

In addition to the basic cause there are numerous factors which stimulate corrosion. Some of the more active are:

Impure metal.

Improperly annealed metal containing internal stresses.

Scratches, indentations, blow holes which become centres for rust.

Effect of stray electric currents from high tension lines, etc.

Effect of impurities in the atmosphere.

---

## THE MANUFACTURE OF ILLUMINATING GAS

Richard B. Ferris, E.E. '17.

Before the cheaper "water gas method" of the production of illuminating gas, was discovered gas was made by the distillation of coal, the product having ammonia, coal tar and other impurities extracted. This gas has a distinct odor, while water gas has not. On account of the danger of suffocation due to the escape of this odorless gas, some municipalities require by law that the gas supplied them have an odor. Water gas being cheaper, it is diluted with enough coal gas to give it an odor.

A plant making this mixed gas would have a double advantage, in being situated on a river, of the large water supply and lower cost of materials, the coal and coke being shipped by barge.

The water used in gas manufacture must be reasonably pure. It has been found by one of the plants situated on the Schuylkill River that that water, treated with soda ash and lime, the sediment being allowed to settle, serves very well.

In this plant the water used for gas manufacture is measured by a device consisting of two calibrated buckets, one of which when full empties into the other. It supplies sixteen gas machines, each of which consists of a generator, a superheater and a carbureter.

Coke is introduced into the generator and brought to incandescence. Then steam and air are blown through until the superheater and carbureter come to the required temperature. A secondary blast of air is then admitted to both of these while the machine is still open. As soon as the fine spray of enriching oil, which adds illuminating qualities to the gas, enters from the carbureter the machine is closed.

The mixture of gas and oil vapor is fixed in the superheater to the permanent gas. From here it goes through the seal pots to the water-cooled condensers.

The oven is charged once every hour with coke from the coal gas retorts. The process runs in cycles of seven minutes each, first a "blow" and then a "run." During the blow, while the machine is open, the blast is led through a fire tube boiler, and the seal pots prevent the escape of gas from the "line."

Water is circulated through the seal pots, carrying away part of the tar content which comes from the enriching oil which was added. It is low in pure carbon, but lighter in gravity than coal gas tar. The oil used comes off in the process of distillation between the burning oils and machine oil. The tar separates from the water on standing.

The gas is led from the seal pots to a water-cooled condenser, consisting of vessels lined with a great number of tubes. More tar separates out here, and is drawn off. The condensers are connected in pairs and rigged so that the coldest water comes in contact with the coolest gas.

In the coal gas section, coal is distilled in retorts. The distillation lasts for about four and one-half to five hours. The coke is removed by a discharge machine and used to heat the retorts, and in the manufacture of the water gas. The charge in each retort is about 400 pounds. The gas is purified in the same manner as the water gas. It is then led through two towers about 100 feet high, called ammonia scrubbers, where the ammonia is removed. From here it passes through flat tanks containing rusted iron and steel turnings and water, where the sulphur compounds of the gas are removed.

The gas goes next to the meter house, where it is measured by the ten 14-foot meters. These meters work on the principle of the Archmides screw, and are accurate to one-half of 1%.

The water gas and coal gas are metered separately, and mixed in the valve house, from where they go to the holders. The illuminating properties of the mixture are constantly tested in the photometer rooms throughout the city.

# The Towne Scientific School Journal

OF THE

## University of Pennsylvania

(WHITNEY MAGAZINE)

Published Quarterly by The Undergraduates of The Towne Scientific School

Subscription . . 25 Cents Per Copy, $1.00 Per Year

Entered as second-class matter Nov. 14th, 1914, at the Post Office at Philadelphia, Pa., under the act of March 3, 1879

Advertising Rates will be furnished upon application to the Business Manager.

Office Hours—1-2 P. M. Room 204, Engineering Building, 34th and Locust Streets




## EDITORIAL

**Engineering Societies.**

Since the formation of a distinct Department of Electrical Engineering there has been a growing desire upon the part of the undergraduates that a student branch of the A. I. E. E. be formed at the University. Without doubt it would be a great benefit for them to become affiliated with the national society, as they could thereby keep in touch with their chosen line. But would this society have any permanence? If it were possible

to stir up sufficient interest to organize such a branch, would it continue to attract the men of the following classes?

Viewed in the cold light of fact and precedence, it seems highly probable that such a branch would be doomed to failure if it was conducted as an entirely separate organization. With the varied distractions of city life, the engineering societies have found it difficult to carry on their work; and only through the earnest and hearty co-operation of the different departments in the Engineering School have they been able to succeed.

By far the best plan, and seemingly the only feasible solution, has been worked out in the joint meetings of the Civil and the Whitney Societies, each society holding its own business meetings, where subjects in its field are discussed, and then both gathering for a short joint session, followed by a smoker or refreshments, and entertainments.

If the Electrical Department feels the necessity of a separate organization, it is hoped that they will follow the example set by the Civil and Whitney Societies. There may be a different field of interest, but above all a unity of purpose remains—that of bringing credit to the University of Pennsylvania.

**Communications.**

At the beginning of the college year the JOURNAL sent out 500 letters to graduates of the Towne Scientific School asking for "lubricant" in the form of a subscription, and "gas" in the form of news or information. The answers received were rather few and far between, but they made up in quality what they lacked in quantity. They all expressed a very kind and encouraging spirit, and several contained news which we have printed already. Here are some samples of the style of letters:

January 6, 1915.

Editor TOWNE SCIENTIFIC SCHOOL JOURNAL.

DEAR SIR: Having sent oil to the circulation manager, I feel it only just to send gas to the editor.

In the first place, I wish to congratulate the staff of the JOURNAL upon the fine paper just put out. It is truly an improve-

ment on the Whitney Magazine, which we thought was pretty good a few years ago.

Have no report to make on any startling research work or great inventions, but heard of a little contest in Chicago recently which might be of interest to the "Made in America" boosters.

About a year ago there were installed in a large Chicago power house what were then the largest turbines in the world. One was an American turbine, while the other was a British machine. There was considerable rivalry between the two erecting crews to beat each other's time. Things went along very nicely, with the American crew gradually forging a little ahead of the British crowd in its construction schedule. To offset this the British engineer arranged for a sort of a celebration, when his machine was lavishly decorated with Canadian emblems, British flags and a large placard bearing this inscription: "25,000 K. W. *Some Bull.*" To answer this a very modest card was put on the other machine, and this is what the Yankee put on it: "20,000 K. W. *No Bull.*"

The American machine carried a commercial load several weeks before the British machine did, and it is regularly carrying a larger load than its foreign competitor. Truly, the Yankee is still ahead.

If it is the purpose of the JOURNAL to observe strict neutrality I will not be offended in the least by failure to publish this story. I am not responsible for it myself. It was handed along to me by a Yankee engineer on the job at the time. It, therefore, has the advantage of being *almost* first handed by the time you get it. With best wishes for the JOURNAL, I am, sincerely yours,

M. S. WEIL,

With Northern Indiana Gas and Electric Co. Hammond, Ind.

---

## FROM A RANK OUTSIDER

This is an old one, but I am going to risk telling it, anyway. If you know it, skip it and begin where it stops.

It's about the lazy old hen who one day spied a lot of beautiful, fine large eggs in a basket in a far corner of the henhouse, where Mr. Man who owned the hen had been attacked with an absent minded fit and forsaken them. Old Mrs. Hen thought they

were left for her especial benefit, and thought it a fine opportunity to raise a nice large family, so she commenced on the spot to start her three weeks' vigil. She sat patiently in the obscure corner, cackling away to herself and swelled up with pride when she thought of the fine brood she should soon have parading behind her.

At last the shells cracked and, to her great surprise and disappointment, out came a most admirable collection of young ducks instead of chicks. It seems that Mr. Man, who raised chickens, also raised ducks, and that he failed to leave a note to that effect when he left the eggs behind him.

I used to be a student in the Towne Scientific School—that is, I was in it enough to be entitled to receive the little yellow notices that begin with "I regret to inform" and end with "John Frazer," but don't consider for a minute that I intended to use the word student in its technical sense.

When I forsook school I also forsook a technical career and entered business. It is because of the latter desertion that I class myself as a rank outsider, and I have asked the editor to let me appear in just that role in the JOURNAL if he decides to print this.

The reason I am writing is this: I know that there must be a lot of fellows who are not sure that they want to follow engineering or architecture and are just wondering whether it is all worth while. I think it is.

You may hatch ducks when you are supposed to be hatching chicks, but if you hadn't sat on the eggs at all you wouldn't have either.

I have found that for all that I really put into my work at school I have received a reward far in excess of anything I ever dreamed of. My only regret in taking a technical course is that I didn't put more into it while I was there.

Dr. Eliot, of Harvard, has said that he would send a boy to college if he only stood against the walls for four years. I don't know how much good that would do, but I know that I acquired a great deal in just about that way. Unconsciously, you are bound to pick up a smattering of lots of things that will be of inestimable value later.

I used to have a stein with the following familiar inscription upon it: "Don't let your studies interfere with your college work,"

and I am afraid that sometimes I may have followed that advice to my own detriment, for I neglected the studies. Nevertheless, I'd advise every one to follow it when changed to read the way it is meant to be interpreted: "Don't let your studies interfere with your activities," with this caution, however: Be sure you don't neglect the studies.

If you have to neglect one or the other, of course neglect the activities, but don't neglect either if you can help it. Get in and work hard at both, but don't let them interfere.

While you're in school go at it with a whole heart and you'll get out far more than you put into it. It's good advice, even for mercenary reasons, whether you "follow up" the profession or desert to join the rank and file in business.


**Douglas D. Ellington,** Arch. '12, winner of the Paris prize, lately returned to this country. The "Duke" was driven home from Paris, where he was studying at the Ecole de Beaux Arts, by the war. Before returning to his country he was employed with clerical work at the American Embassy in Paris after active work at the Ecole stopped. While he was a student at the Ecole, Ellington made quite a reputation for himself, continuing the high type of work for which he made his reputation as an undergraduate at Pennsylvania. He is the first American to win the Rougevin prize, which is one of the most coveted prizes offered by the Paris school.

The James Laurie prize was recently awarded by the American Society of Civil Engineers to **Samuel Tobias Wagner,** B.S. '81, C.E. '84, for his paper on "The Elevation of the Tracks of the Philadelphia, Germantown & Norristown Railway, Philadelphia, Pa."

At the University Council held on February 12th the degree of B.S. in C.E., as of the class of 1894, was conferred on **J. B. Austin, Jr.,** Superintendent of the Long Island Railroad, an office formerly held by **H. W. Thornton,** of the same class, now General Manager of the Great Eastern Railway, London, England.

**Mr. H. Bortin** B.S. in C.E. '07, Assoc. M. Am. Soc. C.E., formerly Engineer in Charge of the Valuation Department of the Union Pacific Railroad, and lately assistant to **Mr. T. W. Hulme,** B.S. '88, C.E. '90, General Secretary of the Presidents' Conference Committee on Federal Valuation of the Railroads, has opened an office at 149 Broadway, New York, for private practice as a consulting valuation engineer.

The Proceedings of the American Society for Civil Engineers for January, 1915, contained an interesting paper on the "Reconstruction of the Norfolk & Western Railway Com-

pany's Bridge Over the Ohio River at Kenova, W. Va.," by **William G. Grove,** B.S. in C.E. **'09,** and **Henry Taylor.** Credit for the development of the plans is also given to **F. P. Witmer,** B.S. **'93,** C.E. **'94.** On the part of the railway company, the execution of this work was under the direction of **J. E. Crawford,** B.S. in C.E. **'97,** Chief Engineer Norfolk & Western Railway Company, and **C. C. Wentworth,** B.S. in C.E. **'76,** Principal Assistant Engineer, Norfolk & Western Railway Company.

One of the features at the recent annual meeting of the American Society of Civil Engineers was an excursion over the lines of the Long Island Railroad Company, of which **J. R. Savage,** B.S. **'88,** C.E. **'89,** is Chief Engineer, and **J. B. Austin,** B.S. in C.E. **'94,** is Superintendent. A number of other graduates of the Department of Civil Engineering connected with the engineering staff of the Long Island Railroad also participated in this excursion and in the extension of courtesies to its guests.

The following is a special cable news item concerning **Mr. H. W. Thornton,** B.S.(C.) **'94,** Manager of the Great Eastern Railway Company, London, to the New York "Times," which appeared in its issue of February 13, 1915:

> "London, Feb. 12.—H. W. Thornton received a handsome compliment today from Lord Claud Hamilton at the annual meeting of the shareholders of the Great Eastern Railway Company.
>
> "When Mr. Thornton was appointed Manager of the railway there was a great outcry in some quarters against the selection of an American for the post, and newspaper controversy followed. Today's meeting was the first general meeting of the stockholders of the Great Eastern since Mr. Thornton assumed the management. One stockholder proposed that he be specially mentioned in a vote of thanks by the Directors, and Lord Claud Hamilton, the Chairman of the company, paid him a special tribute.
>
> "The meeting unanimously agreed that Mr. Thornton had "made good" and had thoroughly justified Lord Claud Hamilton's selection of an American Manager."

At the University Council held on February 12th the degree of E.E. was conferred on **Mr. William McClellan,** Consulting Engineer to the Public Service Commission of the State of New York, and also Consulting Engineer to the American Telephone and Telegraph Company and other interests. **Mr. McClellan** received the degree of B.S. from the

University of Pennsylvania in 1900, and the degree of Ph.D. in 1903. **Mr. McClellan** was the speaker at the February general lecture.

**Raymond Corral,** E.E. '14, is temporarily with the Penn Mutual Life. He expects to return to Mexico as soon as conditions become more settled there.

**L. C. Smith,** E.E. '14, has forsaken engineering to start a chicken farm at Swarthmore, Pa.

**Paul Pennington,** E.E. '14, is with the New York Edison Company.

**E. C. Romine,** M.E. '10, has changed his location from the United Gas Improvement Company to the Central Union Gas, of New York City.

**M. M. Kenedy,** M.E. '14, is Copyist Electrical Draughtsman at the League Island Navy Yard, Philadelphia.

**G. P. Pilling, 3d,** M.E. '12, is superintendent of the Northern Iron Company's blast furnace at Port Henry, N. Y.

**Fred W. Reuter,** M.E. '11, is with the Schutte & Koerting Company, in Philadelphia.

**Fred Morse Holcomb,** Arch. '14, was married to Miss Margaret Montgomery, of Philadelphia, on February 27, 1915. Mr. and Mrs. Holcomb will live in Chicago, where Mr. Holcomb is practicing his profession.


## ELECTRICAL ENGINEERING

The honorary Electrical Engineering Fraternity of Eta Kappa Nu elected its members and held its initiation ceremonies shortly before the Christmas holidays.

At the regular meeting, February 11th, Ralph Ritter, '15, read a paper on the Philadelphia Fire Alarm System. R. D. Sappington, '15, gave an interesting account of his experiences in handling foreign labor. Both papers brought out an interesting and animated discussion.

## CHEMICAL ENGINEERING

The Junior chemists and chemical engineers held their banquet Saturday, February 6th, at the Normandie. The guests of the occasion were Dr. D. L. Wallace and Dr. H. H. Harned, both of the Chemistry Department.

After the dinner and a little informal speech of welcome by the toastmaster, J. Green, toasts were responded to by both Drs. Wallace and Harned.

Several informal speeches were also made by the various students present. The evening closed with a song by Zimmerman and the singing of "Hail Pennsylvania" by all those present.

The committee was: C. Watson Kitner, chairman; J. Weiger, J. J. Fitzpatrick, I. Guest, I. Rosenblatt.

The Class of 1915 Chemical Engineers and Chemists held their third annual banquet at the Cafe Normandie, Thursday evening, February 25th.

Dean Frazier, Professor Fernald, Professors Shinn and Taggert, and Dr. Lukens were the guests of honor. Hugo G. Kirchner acted as toastmaster.

A very fine dinner was served. The favors consisted of crucibles, imitations, that were hard to distinguish from the

real thing. However, the best part of the whole evening was the speaking.

The main topic of the speakers was advice to the graduating students, to prepare them for "the world" in June. Special emphasis was laid upon the present "hard times" and the difficulty of getting a "job"; but Professor Fernald set aside all fear from that source, telling them that in the past all graduates had received positions, and he hoped and felt confident that this year would be no exception.

The arrangements for the banquet were in charge of S. F. Spangler.

---

## THE INTERDEPARTMENT CREW RACE

A short time before the date scheduled for the interclass crew race in the Fall, the Fairmount Dredging Company began the work of deepening the channel in front of the boathouses. In order to get the launch in the boathouse and have the slip removed Mr. Nickalls had to put the interclass race two days ahead, and postpone the engineers' interdepartmental race until the Spring.

Mr. Nickalls called for crew candidates a month earlier this year on account of the race with Yale here on April 3d. Eight new machines have been procured, which the 'Varsity, Junior 'Varsity and first Freshman crews will use until the weather permits rowing on the Schuylkill. On account of the lack of accommodations for the five engineering crews, they will remain at work on the machines until the 'Varsity crews have been quartered in other boathouses along the row.

The date of the race has not yet been decided upon. The committee in charge, consisting of two members from each department, one from the society and the other rowing on the crew, hope to have it on May Day in conjunction with the May Day sports.

By March 1st full crews had reported for the M.E., E.E. and C.E. department. On account of the pressure of work in their departments Lewis, Ch.E., and Shefchick, Arch., have had trouble in forming their eights.

'Varsity, Junior 'Varsity and first Freshman crewmen only are ineligible for the crews.

# TOWNE TOPICS

## ENGINEERS SHOW

## UNDERGRADUATES ELECTED TO SIGMA XI, JANUARY 20, 1915

Malcolm Duncan, C.E.
Arthur B. Harding, M.E.
Raymond C. Hummel, Ch.E.
John H. Jackson, M.E.
James A. Jensen, M.E.
Leo D. Jones, Ch.
William Keith McAfee, E.E.
Sixto Mestres, Ch.
Ralph H. Moore, C.E.
Herbert W. Oetinger, E.E.
Charles W. Plass, E.E.
Cyril V. Smith, Ch.E.
Clement K. Swift, Ch.E.
Robert J. Thompson, M.E.
Stacey H. Widdicombe, C.E.

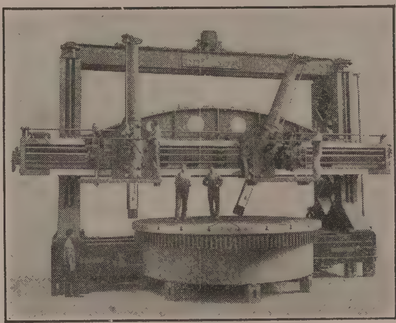
---

## WHITNEY ENGINEERING SOCIETY

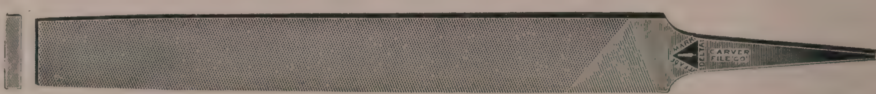
A very interesting meeting was held on Friday evening, February 19th, at which Mr. C. R. Underhill, Chief Electrical Engineer of the Acme Wire Company, gave an interesting talk on "Electromagnets." His talk was illustrated by slides and by some experimental apparatus which he has presented to the Electrical Engineering Department. "Eats" were then served and every one had a good time.

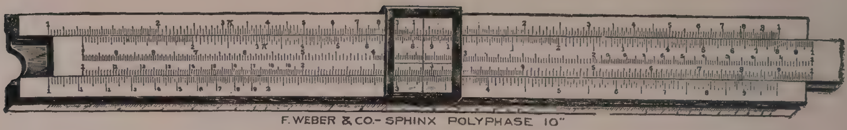
The March meeting will be a smoker, which the C. E. and Whitney Societies will enjoy together. Movies and a good time, eats and smokes, are being planned and a record-breaking attendance is desired.

The annual Engineers' Dance, to be given this year by the C. E. and Whitney Societies, will be held in the Engineering Building on April 28th. Every live engineer will be there with the girl we hear so much about, and we're anxious to see what she looks like. Better make good on some of those boasts about what the engineers can do!










## "SPHINX" POLYPLASE SLIDE RULE

Log, squares and cube scales on front of rule, usor reads answers direct. Line and Tangent scale for small angles.
**10" Rule with Hand Sown Leather Case, $4.50. Can be purchased at Journal office, Room 204**

**F. WEBER & CO.**
**1125 CHESTNUT ST.**
**PHILA., PA.**
**BRANCHES—ST. LOUIS, MO.**
**BALTIMORE, MD.**

**Manufacturers—Importers:—Drawing Materials, Engineering Supplies Artists' Materials.**

---

*Pyrene* TRADE MARK

**"THE MOST EFFICIENT FIRE EXTINGUISHER KNOWN."**

**A scientific means for putting out fires in**

**Schools**
**Colleges**
**Homes**
**Factories**

**Approved by the National Board of Fire Underwriters**

15% saved on Automobile Insurance Premiums by Pyrene Equipment.

**JAMES M. CASTLE, - - 1222-3-4 Lincoln Building**

---

# GILBERT & BACON

***Photographic Studio***

1030 CHESTNUT STREET

**Special rates to Students, Fraternities and Clubs**

---

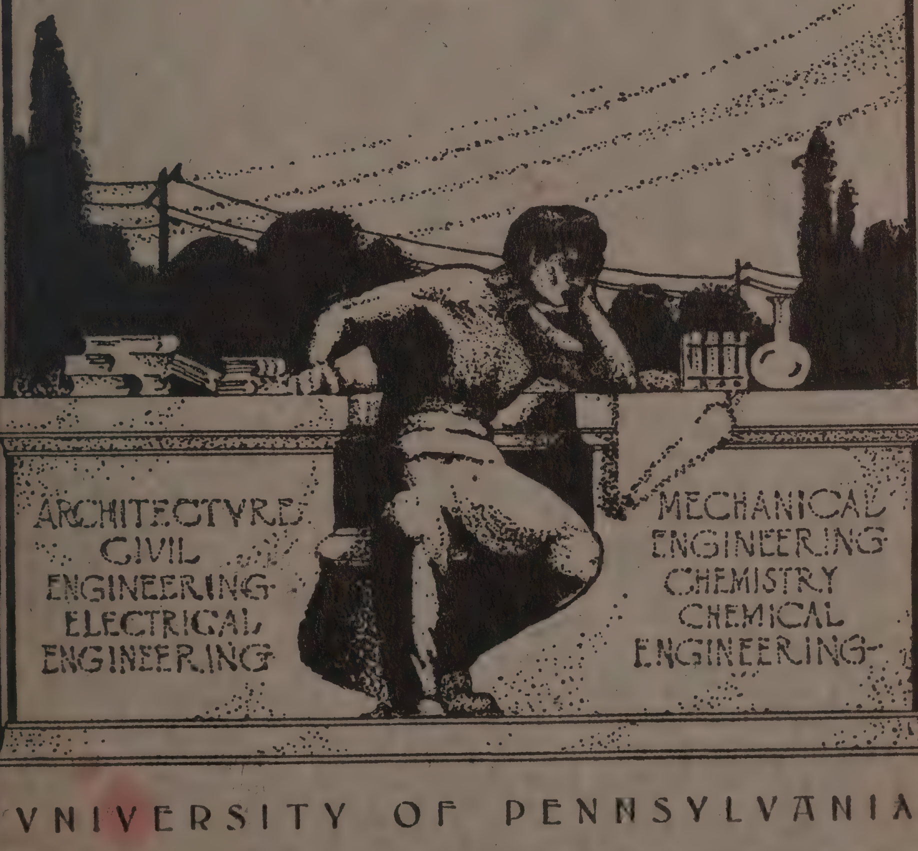
**Muffles**
**Slides**
**Tubes**


**Discs**
**Tiles**
**Supports**

MAY ISSUE

# THE TOWNE SCIENTIFIC SCHOOL JOURNAL

PUBLISHED BY THE UNDERGRADUATES



# Towne Scientific School Journal

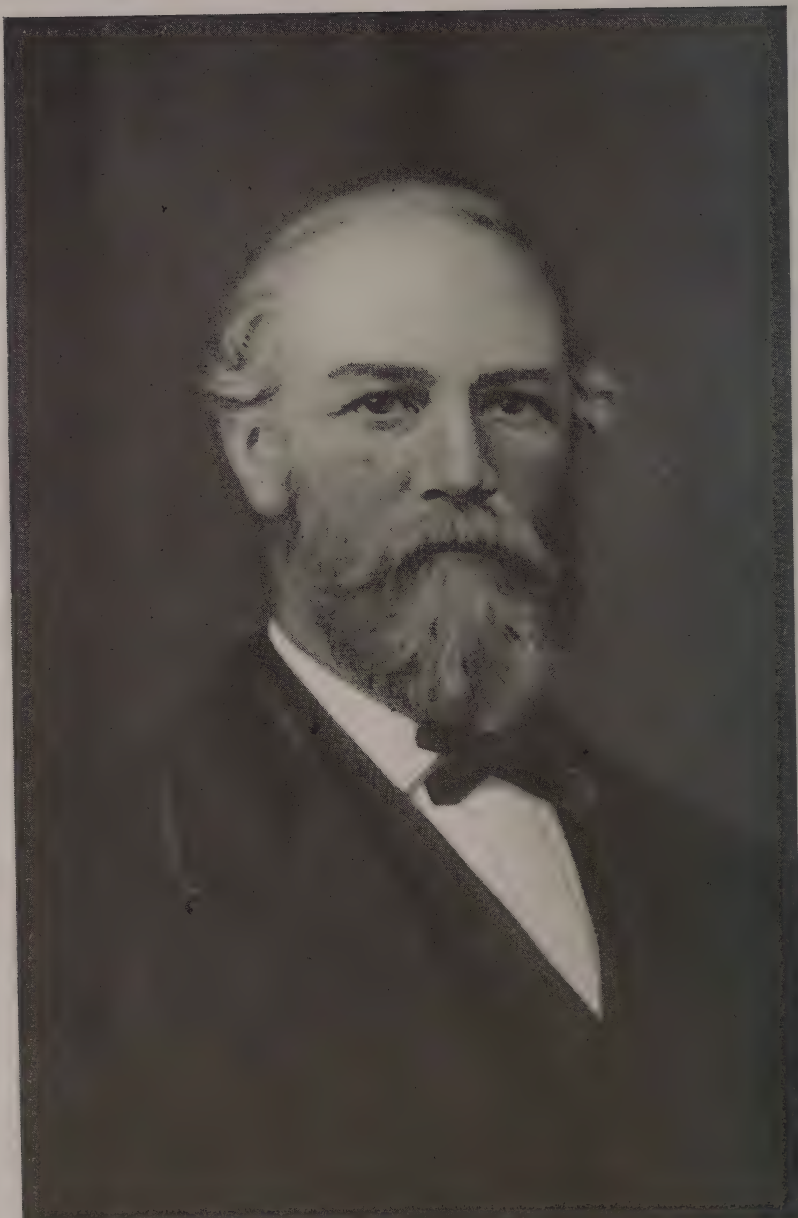
May, 1915

Published by the
UNDERGRADUATES OF THE
Towne Scientific School of the
University of Pennsylvania
Room 204, Engineering Building, U. of P., Philadelphia, Pa.

SUN PRINTING HOUSE, PUBLISHERS
PHILADELPHIA, PA.

# CONTENTS

## May, 1915



JOHN HENRY TOWNE

# The Towne Scientific School Journal

Vol. II MAY, 1915 No. 4

## LIFE OF JOHN HENRY TOWNE

*Biographical Sketch of the Founder of "The Towne Scientific School."**

John Henry Towne, from whom the Towne Scientific School derives its name, was born in Pittsburgh in 1818, and died in Paris, France, in 1875. He moved to Boston with his family when he was about 15, where he attended the Chauncey Hall School for some years, and then went to Philadelphia, where he made his home during the rest of his life. He was of the seventh generation in descent from William Towne, who emigrated from Great Yarmouth, Norfolk, England, in 1640 (only 20 years after the voyage of the "Mayflower") and settled in Salem, Mass., in which vicinity the family remained until John Towne, the father of the subject of this sketch, left there about 1802-03.

John Towne (born 1787) was a man of notable character and achievements, whose undertakings were large for their day, and earned for him ultimately a handsome competence. In partnership with Mr. Henry Robinson, of England, whose sister, Sarah, he subsequently married, he engaged successfully in business in Baltimore until 1817, when he moved to Pittsburgh, where he operated a line of steamboats from Pittsburgh to New Orleans, and did a commission business in cotton and sugar. In 1833 Mr. Robinson, who had previously removed to Boston and become owner of the Boston Gas Works, invited Mr. Towne to join him as a partner and to assume the superintendency of the gas works. Having accepted this offer, Mr. Towne removed his home from Pittsburgh to Boston, where he resided until 1840, when at the age of 53 he retired from business and moved to Philadelphia, where his elder son had preceded him, with his family of five daughters and a younger son. His wife, a woman of fine character, had died in 1833, just prior to the move from Pittsburgh. Here in Philadelphia he purchased a handsome home, still standing (No. 1608 Walnut street), his neighbor on the west being the Hon. William J. Duane, the distinguished lawyer, who drew the will of Stephen Girard, and who, as Secretary of the Treasury, was removed by President Jackson because of his refusal to sign the order (which he disapproved) for the withdrawal of the Federal deposits from the Bank of the United States, and whose

*Prepared, by request of the Editor, by his son, Henry R. Towne.

daughter, Mrs. E. D. Gillespie, has only recently closed her career as one of Philadelphia's most distinguished women. The intimacy then begun between the two families lasted as long as any of them survived.

In 1849 Mr. John Towne purchased a beautiful country seat in the Huntingdon Valley, about 12 miles from Philadelphia (near what is now Bethayres), which he made his home until his death in 1851. He was a lover of the fine arts, and had a collection of paintings which was notable for its day. Among his friends were the artists Leutze, Sully and Peale. He was also a lover of flowers, and in each of his places of residence cultivated them extensively and successfully, especially rare varieties of camellias and heaths.

John Henry Towne, the elder son, had been sent from Boston to Philadelphia to study engineering, for which he had a strong inclination, in the machine shop of Merrick & Agnew, where he showed such ability and aptitude that in 1835 he was admitted to partnership, the firm then becoming Merrick & Towne, and the plant, on Washington avenue, where it still exists, although much enlarged, being designated as the "Southwark Foundry," which title it still bears. Here for the next 13 years he pursued with great activity and success his chosen profession, acting as the chief engineer of the firm in designing and building marine and other heavy machinery, including the engines, designed by Captain John Ericsson, for the U. S. S. "Princeton," the first screw war vessel ever built, and also centrifugal sugar machines from the designs of Mr. N. Rillieux, the original inventor. The firm were also the American builders of the original Nasmyth steam hammer. The friendship formed at this time with Captain Ericsson lasted until the death of Mr. Towne. Among his assistants were included Mr. B. H. Bartol and Mr. Washington Jones, both familiar names in connection with Philadelphia's engineering interests. In 1843 he had married Maria R., daughter of Joshua Tevis, a prominent merchant of Philadelphia, her mother being Rebecca Risteau Carnan, of Baltimore, where the daughter spent much of her girlhood.

In 1847 Mr. Samuel Vaughan Merrick, the senior partner, became the first president of the Pennsylvania Railroad Company (organized in 1846), and, partly because of the changed relations thus involved, the firm was dissolved in 1848.*

For the next few years Mr. Towne engaged in practice as a consulting engineer, specializing in the building and improvement

*NOTE.—Mr. Merrick's home then stood on Penn Square West, near Filbert Street, on ground which is now included in the site of the Broad Street Station, an interesting fact which should be recorded by a suitable tablet in that building.

of gas works. Among those designed and built by him were the original gas works in Savannah, Ga., and New Bedford, Mass. During this period, about 1854, he built the house at No. 1616 Locust street, still standing, which was his home until he died, and a little later bought as a summer home a place near Shoemakertown (now Ogontz) on the line of the North Pennsylvania Railroad, which was then being projected, and which has since become a part of the Reading system.

When the building of this railroad was undertaken, the person chosen as its first president was the Hon. John Welsh, one of Philadelphia's most honored citizens, and a benefactor of the University, to which he gave as an endowment fund the $50,000 presented to him by citizens in appreciation of his work as chairman of the Finance Committee of the Centennial Exposition. Mr. Welsh's many other duties precluding his undertaking the active responsibilities of this new position, he proposed, if indeed he did not stipulate, that Mr. Towne should be induced to serve as vice president, and as such to assume the active responsibility of the undertaking, and Mr. Towne accepted the position on this understanding. Both Mr. Welsh and Mr. Towne served without compensation, the latter devoting himself wholly to the work until, after many trials and difficulties, the road was completed as then projected, and successfully put into operation. On resigning his position, Mr. Towne was the recipient of a beautiful testimonial silver vase* which bore the following inscription:

> "Presented to John Henry Towne, Esq., by the Directors of the North Pennsylvania Railroad Company, in grateful appreciation of his disinterested and valuable services while Vice President of the Company. June, 1857."

Mr. Towne was a life member and an officer of the Franklin Institute, and was long an active director of the Philadelphia & Reading Railroad Company, the Allentown Iron Company, and of several other corporations.

In 1861, impelled by his strong patriotism to resume active work under conditions which would enable him to be of use to his country during the crisis of the Civil War, he became a partner in the firm of I. P. Morris & Co., owners of the Port Richmond Iron Works, now forming part of the Cramp Shipyards, the other partners then being Mr. Isaac P. Morris, Mr. Lewis Taws and Mr. John Thompson. The firm proposed to undertake government work, and desired Mr. Towne's services as its chief engineer. After his admission the firm name became I. P. Morris, Towne & Co. Almost immediately upon the opening of the war the firm

*The vase, which is now in the possession of his son, is 27 inches in height, and cost $1000, a large sum in those days.

was awarded contracts for the engines for some of the earlier gunboats and monitors. Lasting throughout the war, this work embraced the machinery for seven or eight warships, including that for the two double-turreted monitors "Monadnock" and "Agamenticus," built from the designs of Captain Ericsson, with whom Mr. Towne was thus again brought into active professional relations. The firm also built blast engines, sugar machinery, rolling mills, etc., and the Ericsson caloric engine.

About 1869-70 Mr. Towne withdrew from the firm and permanently retired from active business, making his principal home in Philadelphia, and his summer home at Manchester-by-the-Sea, Mass., where he had acquired the estate known as "Eagle Head," which after his death became the principal home of his widow until her death in 1892. His health began to fail in 1874, in the latter part of which year he went to Europe with his wife and younger daughter. His death occurred suddenly in April, 1875, in Paris, and his remains rest in Laurel Hill Cemetery.

He was a man of refined tastes, keenly appreciative of nature, painting, music and science, quiet and somewhat reserved in manner, but deeply interested in current events and ready to act when needed in the service of the public. Among his friends were Dr. William H. Furness and his brother James, Prof. J. P. Lesley, Mr. Joseph Harrison, Mr. William Sellers and his cousin Coleman, Mr. Charles Borie, and Professors John Frazer, E. Otis Kendall and Fairman Rogers, of the University, all familiar names to many Philadelphians still living.

During his later years Mr. Towne served actively as a trustee of the University of Pennsylvania, and in his will made it his residuary legatee, specifying simply, as to the large fund thereby created, that "the income shall be used exclusively for paying the salaries of professors and other instructors in the Department of Science." In recognition of this gift the trustees adopted as the official title of this department the name it now bears, "The Towne Scientific School."

Mr. Towne's children were as follows:

Henry R. Towne, for 46 years president of The Yale & Towne Manufacturing Company, of Stamford, Conn., who resides in New York City.

Helen C., widow of Dr. William F. Jenks, of Philadelphia, who has always made this city her home.

Alice N., wife of Roland C. Lincoln, of Boston, Mass.

# THE SPIRIT OF THE ARCHITECTURAL STUDENT AT PENNSYLVANIA

*An Article written by Prof. Paul P. Cret about the school before actively engaging in the war as a loyal Frenchman.*

When I was told the other day of the difficulty that was being experienced in finding desks and floor-space for the new students who are crowding in such numbers into our department, my mind went back to my own beginnings in the School of Fine Arts in Paris. I arrived there one day in September, and being duly registered, I asked what table would be assigned to me, as I was anxious to start the studies of my first problem.

I was kindly informed by some of my fellow-students whom I had addressed that they were themselves in a great hurry, and that I ought to be able to attend to such trifling matters for myself, without bothering anybody else about it. I got hold of a quiet little corner and disposed my belongings around me without further remarks. I had hardly started to work, when a senior student, somewhat late in arriving and, therefore, all the more impatient on that account, came up to me and requested me without any useless polite formula to get out at once from his reserved space. Being a mere newcomer, I removed my drawing-board, my papers and myself to another location, from which I was again expelled about an hour later. These proceedings being repeated for two or three days, I at last found a harbor of refuge in the stair hall, and there discovered that after all one can study a two months' problem on a drawing-board resting on one side over the railing of the stair and on the other over some books piled upon a stool. Later, I discovered that the studios of architectural students in Paris are in general very primitive, very crowded and indifferently kept, but that all this does not interfere with the good humor and earnestness of the student.

Here, at Pennsylvania, in spite of some slight temporary discomfort, caused by the unexpected number of new students, you will find a much easier way to do your work, and I hope the same stimulating atmosphere. This atmosphere, I want to say right away, is entirely of your own making. It is quite independent of the facilities provided by the school. It depends on some much more settled influences, which I should like to define for you.

What is it that changes a gathering of men engaged in the same pursuit from a mere sum of dissimilar units into a single body in which the power of each member of the group is increased by the presence of all the others? It is the spirit of the group, and this spirit is born of several conditions. There must be in the first place a common aim in the group, common feelings, and a life in common. The common aim is easily enough created by the mere fact that all of you intend to become architects in the broadest sense of the word. A common feeling will come a little later, when having mastered the rudiments of your profession, you begin to have a real interest in art, because you will understand its object. When, instead of merely seeing buildings, you will look at them with a desire to know why they are beautiful or to analyze their shortcoming. When you will have an enthusiasm for some forms of beauty and dislike for others.

In our department more than in any other in the University, the students work together, the midnight oil is burnt in College Hall instead of in one's room, and the many occasions in which you will be called upon to help others or of being helped yourself cannot fail to create a deeper intimacy than would arise from working alone or from attending lectures. That you have to work hard is only another reason why you should determine to be friends, for there are in the world no more enduring ties of friendship than those created by a common hardship.

It is through such agencies as these which are in a sense a part of our school that the spirit of the school has been created and will be maintained. The younger men have thus received something from the older, advice and example, while the elder men were helped in the final stage of large problems by the younger, to the benefit of both. I need only refer to the recent successes of the school to show what such a spirit can do.

Renan has given this fine definition: "What is it that causes men to become a great nation? It is the memory of great things done together, and the determination to do new ones." Small as our body of students and instructors is, compared to a nation, we have nevertheless some use for this thought. In our school, the efforts of our predecessors have made a reputation which we have to be worthy of. We are responsible for the good name of the

THE TREATMENT OF THE BANKS OF A RIVER FLANKING A NATURAL FALL. *2d Medal Beaux Arts.* KENNETH WELCH

Pennsylvania Architectural Student. I do not mean by this that success in competition is necessarily our chief aim, but we must always keep in mind the Latin proverb, "Do well what you have to do."

I have insisted so far on one side only of your student life. The departmental side, which is to the general University spirit what the love of one city is to the broader love of one's country. This broader relation has been explained to you by others and I need not emphasize it again. Indeed, there has been no year in which our School of Architecture has not given to the general University activities distinguished representatives. I have, therefore, little fear that the spirit of architectural students will run counter to the spirit of the Pennsylvania man.

For the majority of the students whom I am addressing this afternoon, these suggestions are not needed, but I hope I may be excused for having in mind more specially our entering class, in whose hands lies the future reputation of our school. So far this entering class has been mostly occupied by filling out course cards with names and cabalistic numbers. I should like to add a few words on the reasons which have made our course what it is.

The fact that you are to become architects requires a simultaneous training, along widely different lines of human pursuits. Independently of this general education that every professional man should have, and that a university must exact from all its graduates, your training must also be artistic and scientific.

This fact often occasions some dissatisfaction among our men, because those who are of a specially scientific turn of mind are apt to fail lamentably in their artistic studies, while others, attracted to our profession by its artistic possibilities, find the scientific courses a pill which is all the more bitter because unexpected. Nobody can be held responsible for this situation. The civilization in which we live has created many problems unknown to the builders of Greece, or of the Renaissance, and it is an ill not easily remedied. That the average civilization of the United States demands some complicated system in our homes in place of the open fireplaces of our forefathers; that an office building has a mechanical equipment more complicated than a temple; all this is perhaps unpleasant, but it is nevertheless true, and we have to deal with it by fitting ourselves to the new conditions. Some recent writers have advocated a specialization of architects into designers, engineers and business managers. I am afraid that this scheme would lead only to the subordination of two of the specialists to the third one, and that the third one would be neither the designer nor the engineer. I do not propose to discuss the consequences that this problematical change would bring about in modern architecture. Moreover, I believe that it is an illusion to think that any of these men could be proficient without an

intelligent comprehension of the aims of the two others, and as this intelligent comprehension is not to be acquired without study, we are brought back to the present requisites of an architect as covered by our own curriculum.

Your time is then to be divided among three main groups of studies, keeping in mind that they are closely dependent each upon the others; that you will never be a good designer unless your studies in descriptive geometry and perspective have trained you to see in space what you wish to represent in a geometrical drawing. That all your design work requires a training of your eye and of your hand that is only to be acquired through long practice in freehand drawing. That a design which has not been studied with regard to constructive requirements is a bad design, and finally, that to miss the opportunity that is offered you here of becoming men of culture by making the most of your course in English, in foreign languages, in the history of the Fine Arts, is possibly not to compromise your future success as architects, but it will set you out from the companionship of the flower of the human mind, the great writers and the great artists of the past.

It only remains for me in conclusion to wish you good success in your efforts and a patient mind. In the evenings in spring the quiet streets of West Philadelphia become a practice field for baseball players, who continue for hours together tossing a ball from one to the other. When I saw them for the first time I wondered what pleasure they could find in that monotonous exchange. Later, when I was initiated as a spectator on Franklin Field into a championship game, I understood that the wonderful throws and the power of obeying perfectly any impulse of the mind were the reward of the dullness of those many hours of practice. Here we also ask of you many hours of practice, but you may be certain that you will not regret them when finally you get into the game.

# GAS PRODUCERS

FRANK A. EPPS, M.E. 1916.

The advent of the gas producer has opened a new field for cheap power production. The power demand of 80 per cent. of European and American manufacturers is under 300 horsepower. Steam-driven units of this size are comparatively uneconomical. Hence the choice for motive power lies between electrical energy taken from the public supply, illuminating gas, gasoline and a private source of power from gas producers and gas engines. Gasoline is too expensize for large power units. Electricity and gas are available at cheap rates only in large towns, but even here the comparative cost of operation favors the private gas producing plant.

The general economy of the steam engine improves as the size of the unit increases, but for the smaller plant the gas engine is the cheapest solution. Where modern steam and gas engines are running in the same power house, it has been found that the latter give out just twice as much power for a given weight of fuel as can be obtained from the former. This result is most encouraging when it is remembered that the large gas engines and gas producers are practically in their infancy. At the present time gas producer power is just becoming known in the United States. England and France are associated with its early development.

Gas producers may be divided into three general classes:

1. The suction gas producer.
2. The pressure gas producer for non-bituminous fuel.
3. The pressure gas producer for bituminous fuel.

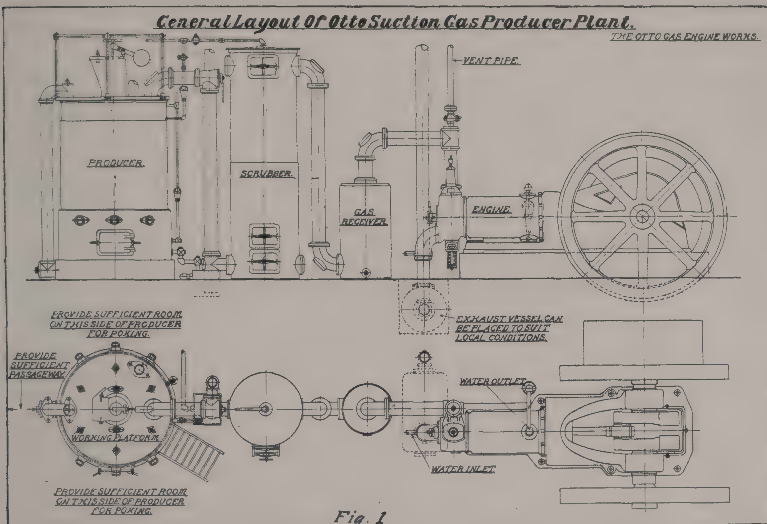
## THE SUCTION GAS PRODUCER.

It is well known that the cycle of events in an internal combustion engine call for the suction, compression, ignition and exhaust of the charge. It follows, therefore, that if the engine be directly connected to a gas producer it will suck out the gas as it is generated, and will automatically regulate the amount of gas evolved in the producer to suit the load which the engine is called upon to meet. This arrangement is found to work well in practice, and the type of gas producer required is called the suction gas producer. Figure 1 shows the external appearance of an Otto suction gas producer.

In general, this type of gas-making plant consists essentially of the gas "generator" or "producer" in which the fuel is burned, and the long, cylindrical vessel or "scrubber" which is filled with damp coke. In passing through this damp coke on its way to the engine the gas is cleaned and cooled.

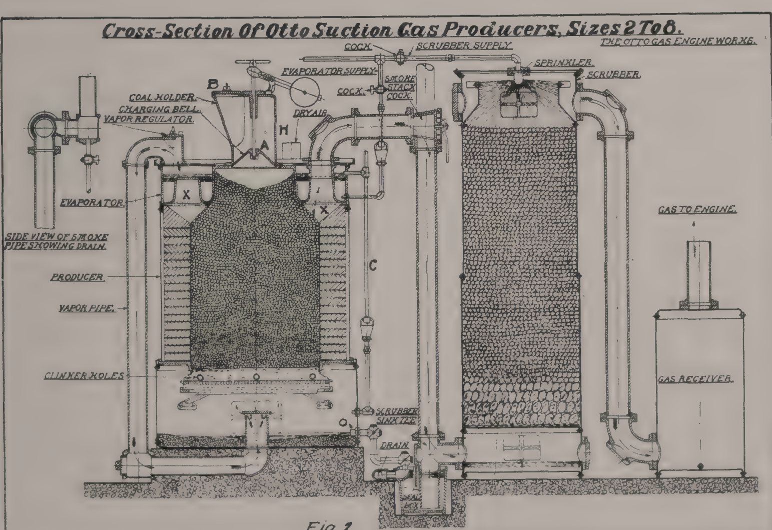
The general action of the plant is as follows: (See Fig. 2.)

1. The engine draws its charge from the gas receiver which is directly connected to the top of the scrubber. The scrubber




General Layout Of Otto Suction Gas Producer Plant.

Fig. 1




Cross-Section Of Otto Suction Gas Producers, Sizes 2 To 8.

Fig. 2

receives its supply from the gas outlet pipe, which connects the producer to the scrubber. This outlet pipe is connected in such a way as to draw off from the producer the gas which is made by

the partial combustion of the fuel in the generator.

2. Every time the engine sucks a charge of gas the sucking action is communicated throughout the plant until it is felt right at the furnace of the producer. A definite air inlet is provided at the bottom of the producer to allow the entrance of the air required to make additional gas to replace that drawn off by the engine. Thus the production of gas is quite automatic and in accordance with the demand made by the engine.

3. For the proper production of gas and the good working of the producer, steam must be admitted with the air passing into the generator, so as to keep down the temperature of the latter, and prevent the body of the generator from cracking, and keep the grate bars from burning out. Since the gas coming off at the top of the producer is highly heated, it is used to vaporize the water required for the steam supply.

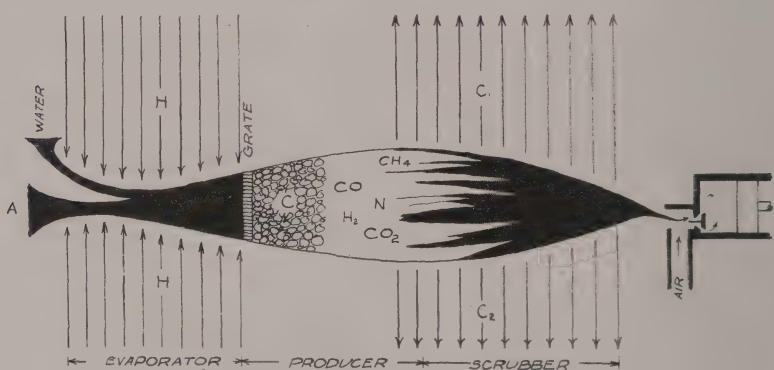


Fig. 3.

Referring to Fig. 2, which is a cross-section of the Otto suction gas producer shown in Fig. 1, the evaporator consists of a trough of water surrounding the upper part of the furnace. The hot gases circulate around in the space marked "X" before going through the outlet pipe. Thus the water in the trough becomes heated and the dry air coming in at H passes over its surface and becomes saturated. Then upon passing down the vapor pipe the air carries the requisite steam to the fire.

At the bottom of the gas outlet pipe is a seal box of the water seal variety. This is principally used as a safeguard against explosions which may occur in the system.

Any water that overflows from the evaporator is carried to the ash pit by overflow pipe C. A drain connects the ash pit to the seal box, which keeps the water from becoming too deep in the ash pit. It is well to have some water in the ash pit when starting, since the water in the evaporator has not had the time to

warm, and consequently the water in the ash pit has to partially furnish the necessary moisture.

Professor Dalby, in a paper read before the British Association in 1906, admirably summarized the general action as follows:

"Fig. 3 is a diagrammatic representation of a plant. The gas current through the plant is put on a rack, as it were, and stretched out to a straight line. To the right of the diagram will be seen the engine cylinder, which acts as a pulse to the system. When the piston moves out to the right the pressure is reduced all through the plant, and air is drawn in at the points A and B. Confining our attention to the air entering at A, it makes its way through what might be called the "tube" and receives heat in the region marked H, thus increasing its capacity to absorb moisture. Water enters in this region, and the heated air, acting as a sponge, saturates itself with water vapor, and then passes on to the grate of the producer, where it passes through an anthracite or coke fire. It will be observed that at this stage the quantities entering into this process for one pound of carbon are 4.5 pounds of air and about .084 pounds of water. Chemical changes now take place, the air and the absorbed moisture become transformed after the passage through the fire into a gas containing roughly 29 pounds of carbon mononide, 1½ pounds of methane, 57 pounds of nitrogen and 12 pounds of carbon dioxide per 100 pounds. The density of the gas in this state is small, and therefore if it were taken direct into the cylinder a charge of small energy value would be obtained. It is therefore necessary to cool the gas down to something like the atmospheric temperature during its passage through the region marked $C_1$ and $C_2$. The gas then, in some cases, emerges into an expansion chamber placed close to the engine. The movement of the piston to the right causes a flow of air and steam into the apparatus at the left, which undergoes a series of complicated reactions in the producer part, and at the same time draws gas from the apparatus and combines it with a suitable mixture of air to form the explosive mixture. At the end of this suction stroke the producer is cut off from connection with the engine by the closing of the valves G, M, and the remaining three strokes of the Otto cycle are completed. These operations are all perfectly straightforward, and present no apparent difficulties. But the extraordinary feature of the suction plant is that an engine can go on working continuously, and these operations can go on minute after minute, hour after hour, and day after day, so that the explosive mixture made in the mixing chamber, and the power developed by the cycle of operations in the cylinder, are automatically regulated to enable the engine to run on a variable load without the necessity of altering the position of a single valve or handle.

It will be observed [in Fig. 3] that heat is taken into the

system in the region H, and is expelled again in the regions marked $C_1$ and $C_2$, and it will be at once apparent that if heat is to be taken away from the region C, and is to be introduced in the region H, the apparatus may be so constructed that the heat rejected at C is used again at H, thus introducing the principle of regeneration."

As before stated, if air alone was led through the furnace, upon coming out it would be so highly heated (over 1500 degrees Centigrade) as to be worthless for immediate use in the engine, and complicated cooling appliances would be necessary. The admission of steam not only prevents grate bars from burning out and keeps down the temperature of the whole, preventing the formation of clinker, but it also enriches the gas by the reactions,

$H_2O + C = H_2 + CO$

Or $2H_2O + C = 2H_2 + CO_2$

Both reactions take place. In both the hydrogen component enriches the gas; in the former, the carbon monoxide is also a combustible product. Hence of the two, the former reaction is the more efficient and uses less steam. This allows a higher temperature; in fact, this reaction can only occur at a temperature of about 1000 degrees C. The temperature of this reaction also favors the maintenance of carbon monoxide in equilibrium and prevents such reversible reactions producing carbon dioxide as,

$$CO + H_2O = CO_2 + H_2$$

from taking place.

The steam supply of the producer should therefore be kept well under control, so that the working temperature can be kept as high as possible, consistent with the prevention of the excessive formation of clinker. An excess of steam lowering the temperature all around is generally against efficiency and prevents the production of good gas. Thus, the importance of designing the evaporators or vaporizers of suction producers to effectively control the steam supply cannot be overestimated. In a well-designed furnace the air enters the grate at about 160 degrees Fahr., being preheated in passing through the vaporizer. If this air becomes completely saturated it will carry too much steam for the production of the best quality of gas. This point will be referred to again in the discussion on vaporizer design.

Anthracite, where obtainable, is the best fuel, as is readily seen from the table below.

Constituents of producer fuels:

| | Carbon. | Volatile Matter. | Ash. |
|---|---|---|---|
| Anthracite .................... | 92.5% | 6% | 1.5% |
| Non-caking bituminous coal...... | 72.0% | 20% | 8.0% |
| Gas coke...................... | 85.0% | 6% | 9.0% |

If the volatile matter appears as tar in the gas an extensive scrubbing apparatus must be employed to extract it, as this tar causes the engine valves to stick, and leads to other difficulties.

If the ash forms a vitreous clinker trouble will be caused by the latter becoming attached to the sides of the interior of the producer. Gradually the effective dimensions of the furnace are so restricted as to interfere with the production of a sufficient quantity of good gas.

It follows from these considerations, taken in conjunction with the fuel composition given in the table, that anthracite coal and good, clean coke or charcoal are the only suitable fuels for use in a suction producer.

### Pressure Plants for Bituminous Fuel.

The chief distinctive differences between bituminous gas plants and those already considered are:

(1) More elaborate scrubbers are necessary to effectively remove the tarry vapors.

(2) The construction of the producer must be modified for the treatment of the large percentage of ash which tends to form excessive clinker.

Bituminous producers are seldom made smaller than 500 H. P., since the advantages of the cheaper fuel are more than counterbalanced in small producers by the increased initial cost of a larger plant and the extra cost for attendance.

The general nature of the reactions which take place in a bituminous producer are the same as already stated. With this type of producer, the temperature should be kept low enough to prevent the excessive formation of clinker, and no more steam should be used for this purpose than is necessary.

The question of peat as a fuel has not yet arisen in a practical form, so far as this country is concerned, as it cannot compete with bituminous coal when the latter is available at a reasonable price, for the simple reason that coal has a much higher heating value, and naturally it does not pay to use the poor fuel when the better quality is to be had readily. An important factor to be borne in mind in connection with peat, however, is its richness in nitrogen, and ammonia recovery is therefore advantageous. Peat producers in conjunction with recovery apparatus are on this account being increasingly employed abroad.

Atmospheric coolers consist of long, vertical tubular containers connected in series between the producer and the scrubber and are exposed to the open air. When these coolers are adopted the required cooling surface is approximately seven square feet per horsepower.

The efficiency of bituminous plants as described is as high as 77.8%. By-product recovery seems likely to play an important part in the future, owing to the increasing attention which is being given to the utilization of the less rich and partially formed fuels, such as peat and lignite. These are comparatively richer in nitrogen than ordinary coal, and this factor makes the recovery correspondingly of greater importance.

It is realized by all who are concerned with the design and construction of large gas engine and large gas plant units that much yet remains to be done before the fullest economies, which appear to be reasonably possible, are brought within the region of actual practice. But the results which have actually been achieved within the last few years and the rapid progress which has been witnessed during that time are full of encouragement to all interested. So far as large gas plants are concerned, greater simplicity and sounder constructional details are the chief points to which attention should be directed, though even in the meanwhile power users will find that the claims of gas power are so numerous and well founded that in the hands of a good firm they will have no difficulty in securing results which will well justify the adoption of this method of driving the power and heat that they require.

---

## SPEED

When man binds the earth with his iron thong
So the fast expresses may bowl along,
And the freights rush by with their heavy load,
It's the smallest grade and the straightest road.
"Tunnel the hills—don't risk the climb,
If it saves a minute. Oh, precious Time!
You can have more money when that is spent;—
But you can't have the grade more than two per cent."

W. H. W. S.

# VACATION NOTES

## *Interesting Engineering Features of an European Trip.*

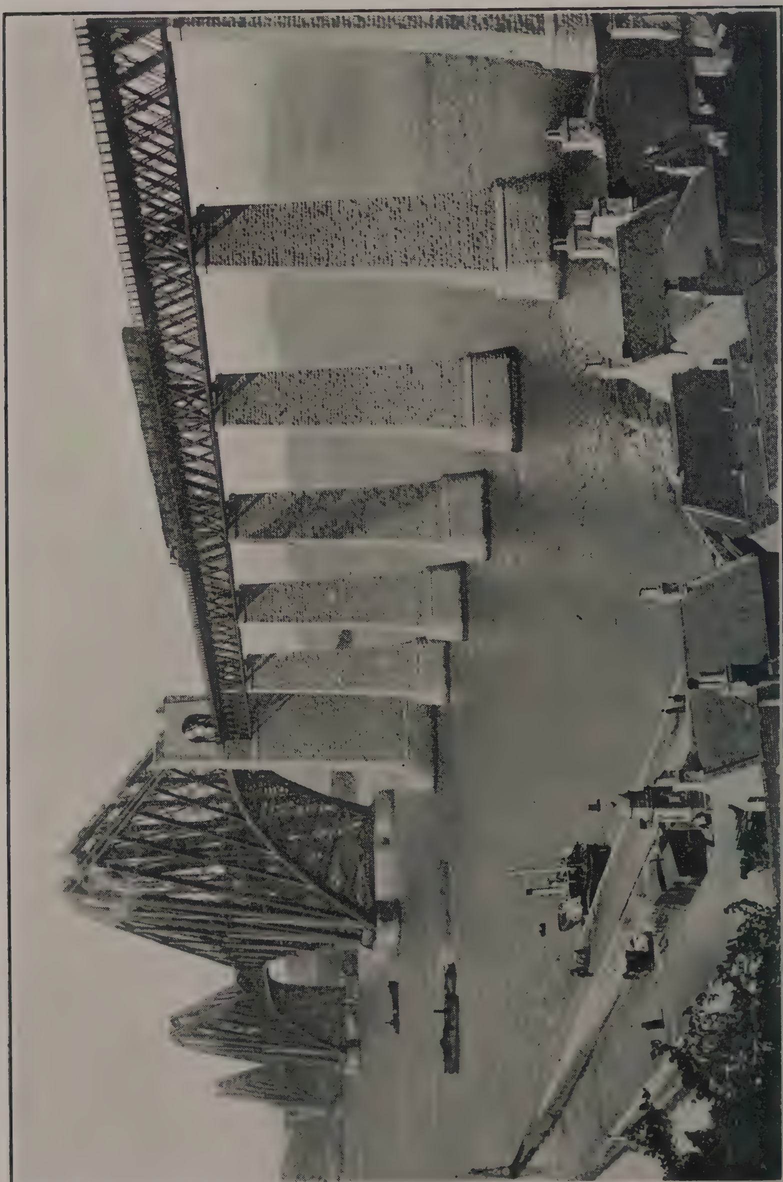
Professor Frederick H. Safford.

The engineering student visiting a foreign country will find many interesting sights not recorded in the guide books. Without entering a picture gallery or cathedral, he will be able to pass a most profitable vacation and learn of things unheeded by the average traveler. In Liverpool, England, he will take a double-decked "tram" to the railway station and there enter a small passenger car with perhaps only six wheels and no corridor. If the train should be a non-stop one, the guard may take his ticket before starting and lock him in his compartment, from which he will be released by another guard at his destination. Certain ancient tunnels have permanently restricted the size of the cars, while the few 8-foot gauge lines in other sections have been changed to standard gauge.

Not long ago the American passengers on a "boat special" from Liverpool to London were edified to find that they had been drawn by a "single cylinder" engine just 55 years old. On one important line only 35 per cent. of the express locomotives are less than 20 years old and many are over 40.

Passengers who land at Fishguard travel to London through the Severn Tunnel under the Bristol Channel. Built in 1886 at a cost of $10,000,000, it is 4 1-3 miles long, double tracked, and in places only 40 feet below the ocean bed. A few miles from the southern end of this tunnel, in the town of Bristol, is a cliff railway with a grade of about one in two, four-tracked throughout, the entire line being in a tunnel about 400 feet long.

The cars are joined in pairs by a rope passing over a large pulley at the top of the incline, so that one car goes up as the other comes down. The motive power is the weight of the water in a tank under the floor of each car. This tank is filled at the top station and is emptied at the bottom station into a waste tank, from which a gas engine pumps constantly to the supply tank at the top. A similar railway joins the villages of Lynton and Lynmouth, on the Devonshire coast. This line is 900 feet long and rises 490 feet, being constructed with a factor of safety of 10. As water is abundant at the upper level, the discharge at the bottom is into the ocean. The right of way is narrow and the two-track overlap throughout except at the midway point where the up and down cars pass. The guard on the upper platform of each car operates a hand wheel, which keeps the brakes off, other-



FORTH BRIDGE. LENGTH 8296 FT. HEIGHT 354 FT. SPANS 1700 FT.

wise they would be applied automatically; acting on the principle of the "dead man's handle." After one has made a few trips on the tops of London busses a desire for speed sends him into the underground, or the "tubes." Tickets for short distances may be had from automatic machines, similar to the stamp vending machines found in Germany. These lines are mainly electric, with American-built locomotives and elevators, for the stations vary from 60 feet to 183 feet below the surface. The actual tubes are 12 feet in diameter, in parallel pairs, and enlarge into cylindrical stations 21 feet in diameter. The Greathead shield was used for much of the construction, and the tunnels under the Thames are in blue clay, which is entirely dry.

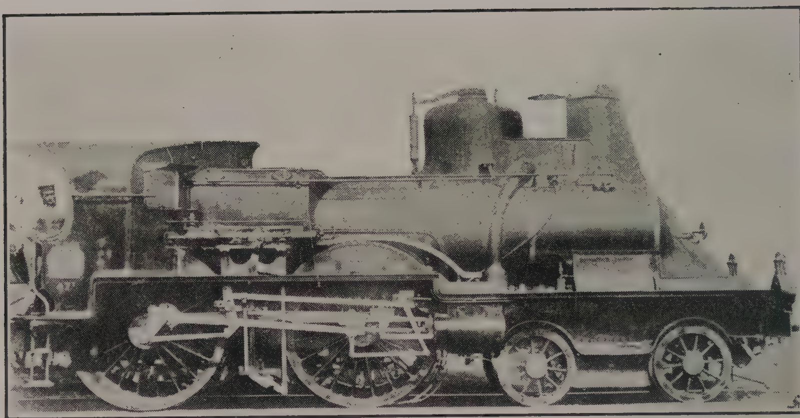
Near Bangor, in Wales, is the Menoi suspension bridge, across Menoi Straits, built by Telford in 1819-20, and up to date the longest of its type in England, being 580 feet between piers and 1000 feet over all. There are 16 chains, 1735 feet long, passing through 60 feet of solid rock at each end, where the sight of the underground anchorage is worth the shilling fee for admission. In sight of this bridge is the Britannia tubular bridge, through which one passes by train, taking a ticket from Bangor to Llanfairprollgwyngyllgogerychroyrndrobroll - llantysiliogogogoch. As the price of the ticket, 7 cents, would not pay enough profit over the cost of the pasteboard the railroad has cut the name down to Lenfair.

This bridge was built by Robert Stephenson, 1846-50, and consists of parallel rectangular tubes each 1840 feet long and with a total weight of 10,000 tons. These tubes were floated into position by pontoons; a wonderful feat for that time. Stone lions at the entrances are 12 feet high and 20 feet long, with grotesquely human faces.

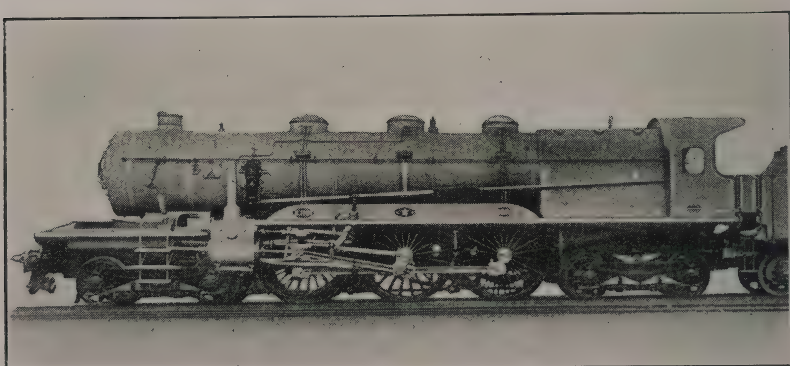
Two bridges in Scotland are well worth the long trip to reach them. The Tay bridge, at Dundee, is 10,780 feet long, but is made up of numerous short spans resting on piers close to those which supported its all-fated predecessor. On December 28, 1879, a train with 55 passengers was crossing the bridge in a storm and disappeared, leaving no survivors. The locomotive was later recovered; has since been twice rebuilt, and in 1913 was still in use.

Not far from Dundee a horsecar with one horse gave us a homesick feeling, for, with the exception of Cambridge, England, which has four or more horsecars, we could hardly expect to see another until we returned to New York.

A charming trip south through Dumfernline, where Andrew Carnegie was born, brings us to Edinburgh and the crowning engineering feat of the Forth bridge. Originally intended to be a suspension bridge, the fall of the Tay bridge caused a change of plans to the present cantilever, built in 1883-90 at a cost of



French Locomotive—Freight



French Locomotive—Express

$15,000,000. Its total length, including approaches, is 2765 yards, and it required 5,000,000 rivets, 60,000 tons of steel and the labor of 4600 men. The main members are tubular, with a diameter of 12 feet. The foundation of the piers is 90 feet below high water and the top of the bridge is 360 feet above high water.

On the way to Dover we may stop at Canterbury and find there a little public park which has on a pedestal the locomotive "Invicta,", 1830, which was Stephenson's No. 12; the world-famous Rocket, now in South Kensington Museum, being No. 11.

As the tunnel from Dover to Calais still only exists on paper the passage is made by boat, with the waves all apparently on the beam.

On first arriving in Paris one is tempted to try the train on the Ceinture in visiting the suburbs. Some of the cars have two stories, like the street cars; the upper are seats called "imperiale," but are exposed to smoke and dust in the many tunnels. In the centre of the train a "White House" often proves an attraction.

In the underground, which is true to its name except for a few elevated portions, we may travel second class at 3 cents for any distance, and with care at junction points there appeared no obstacle to prevent one from riding all day. The trains usually consist of five cars, of which the middle one only is first class. The first class has much better accommodations than the others and requires an extra fare, with the added pleasure of a conductor who occasionally inspects your tickets.

In Germany, too, the trams and trains are interesting. Nuremberg has a museum possessing an unexcelled collection of small working models of locomotives of all types, but the best general museum in Germany is the Deutscher Museum in Munich, which "is not only Germany's greatest museum, but may fairly be esteemed the most important institution in the Fatherland." Here is the original air pump of Otto von Guericke, and beside it the hollow hemisphere of brass, about two feet in diameter, famous in history as the Magdeburg sphere. A large painting shows horses trying to pull them apart.

Other original pieces of apparatus are the first lithographic press, the spectroscopic apparatus of Fraunhofer, the electrical apparatus of Ampere and the first electric motor vehicle of Werner-Siemens. We may also view the 25 Leyden jars used by Ohm and the mechanism with which Hertz demonstrated the electro-magnetic nature of light and so laid the foundation of wireless telegraphy. There are 68 rooms, each devoted to a particular department of science. In several places are signs stating that on request a guard will operate the models. But in most instances one is free to "make the wheels go round" at his own pleasure. Many small locomotives are so arranged that when an air valve is opened the driving wheels are set in motion, and one

Typical English Express Train

Menai Suspension Bridge.

model is placed upside down to afford a better inside view. Not far away stands a full size locomotive with one side of the boiler entirely cut away and its cylinders and steam chests similarly open to view. There is a refreshing absence of "Verboten" signs.

If we have grown up with the idea that the Rhine is wholly a river of scenery and legend we are surprised to find that its swift current carries numbers of long freight barges, and that at the present day it is a great commercial highway, with railway lines on both banks and a tunnel under the Lorelei.

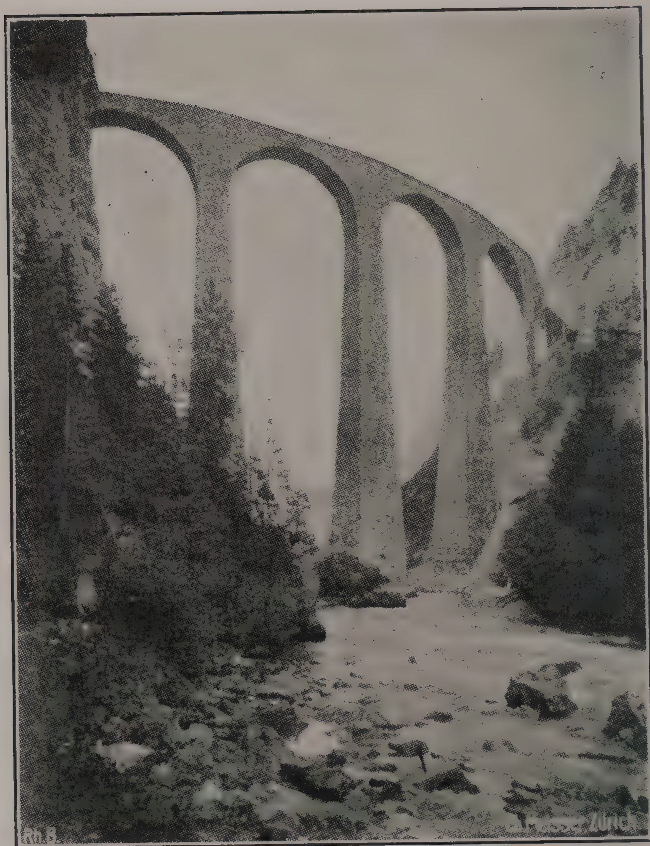
At Coblenz is an interesting bridge of boats. To allow the steamers to pass through two of the boats joined together break ranks and quickly pass to one side, propelled by a small engine and guided by chains on the river bottom. Many of the freight barges are also propelled by picking up a chain from the river bed and passing it over sheaves on their decks operated by steam power.

The famous Strassburg clock draws crowds of visitors at noon—*i. e.*, local time, for it has never been changed to standard time. The original clock was built in 1352, was replaced in 1571 and completely renewed in 1838. It shows the position of 5000 stars, motions of the visible planets, the phases of the moon, true time, sideral time, perpetual calendar, "eclipses of sun and moon calculated forever." A postcard representation of its face, with a movable dial to lend a semblance of mechanism, is sold by the ever-present hawkers. On this is the remarkable statement: "On December 31 of each year, at midnight, this wonderful clock automatically regulates itself."

The mountains of Switzerland, of course, furnish great opportunities for engineering skill, but we can name only a few of the many interesting examples. The railroad through the Brunig Pass has the rack and pinion construction in the steeper portions, with small locomotives adapted to both kinds of traction. On the rack portions cogwheels under the passenger coaches go into mesh, so that their brake gear becomes effective.

One of the longest tunnels in Europe is the Simplon, 12½ miles, built 1898-08, at a cost of $14,000,000. The completed tunnel will have parallel tubes 56 feet apart, but only one is completed to full size.

The following was published in 1908: "The openings of the tunnel on each side will look like great doors of some mediæval fortress. Suppose Italy and Switzerland should fall out; they would rush through that tunnel and invade each other? Indeed they would not. In the little fortress in each end will be a man and a button. The man will press the button and bring down the mountains. When the smoke lifts there will no longer be a tunnel."




Rhaetian Railway

In certain portions of this tunnel the arches are of granite 3 feet thick and the side walls are 10 feet thick.

The St. Gotthard Tunnel, built in 1872-80, has two tracks and is 9¼ miles long. The trip from Lucerne through the tunnel to Lugano is thrilling, for in addition to numerous short tunnels

there are five spiral tunnels, where the track has 300 feet radius and the compass needle moves through a complete circle. At the end toward Italy, but still on Swiss soil, there are fortifications to prevent invasion.

The last, and one of the most interesting engineering feats of which space permits mention, is the Rhaetian Railway in southeastern Switzerland leading to St. Moritz. Its narrow gauge, one meter, allows curves of shorter radius than the St. Gothard Railway, and though sharp grades are frequent no rack and pinion track is required. The longest tunnel is 3¾ miles in length, and there are 39 others with a total length of 6½ miles, with numerous viaducts having a total length of 1½ miles. Several of the tunnels make complete circles, so that a train often emerges directly above the entrance, giving views at times of four levels of track.

The leaning tower at St. Moritz is a prominent feature of the town.

# MANUFACTURING ROUTINE IN A BEE HIVE OVEN COKING PLANT

H. B. PRICE, JR., M.E. 1910.

In the following few words on the manufacture of coke in the Bee Hive oven, the writer will endeavor to make clear the methods of manufacturing coke in the above type oven from the time the coal is dumped from the mine car to the time of loading the car containing the coke for shipment.

The coal is dumped from the mine car into a hopper which delivers the coal to shaker screens. The screenings or slack made from the run-of-mine coal on the screens is then conveyed to a crusher, where it is crushed so that 92 per cent. will go through a quarter-inch screen. From the crusher the coal is elevated to a bin, where a conveyor distributes it to bins.

The larries, or steel cars, which carry the crushed coal from the bin to the ovens are next in line. Running underneath the bin, they receive the coal and proceed over the top of the ovens to the oven to be charged. These cars have a capacity of not over ten tons, and since the charge never exceeds that amount, it is readily seen that one larry full of coal will suffice for an oven. The larry operator, or charge cutter, as he is called, fills the car with the proper amount and then proceeds to the oven to be charged.

In charging, a chute through which the slack enters is lowered from the larry into the trunnel head, or chimney of the oven. The operator must rake every bit of coal which may remain on top into the oven in order to hold the percentage of loss as low as possible.

After charging, the coal in the oven is leveled by means of a hoe, or beaver, about 18 feet long. When this is finished the door is built up with a special fire clay brick and the joints sealed tightly with mud.

The fire brick lining of the oven has a great capacity for holding heat from charge to charge. As soon as the oven is sealed up after leveling, this inherent heat contained in the fire brick lining of the oven raises the temperature of the slack coal in the oven.

In coking, the object is to burn out all the volatile matter contained in the coal. The first indication that the coking process has begun is that a light blue smoke arises from the trunnel head—in other words, the coal has begun to volatilize. This blue smoke will finally change to a yellowish-brown color, and finally the heat will become so intense that these gaseous products will ignite and a flame will be noticed on top of the whole area of coal. The charge is then said to be "caught up," and the operator

starts a draught in the oven by removing a portion of the mud sealing the door along the top, only admitting sufficient air for the combustion of the volatile matter being given off. When this is done a flame is seen coming out of the trunnel head. When the coking process is about half completed this flame will drop and split up in fingers, showing that the quantity of air being admitted is too large. The attendant then gradually reduces the draught by placing mud over the draught opening until the proper amount of air is admitted, which is indicated by the flame becoming larger and as one flame.

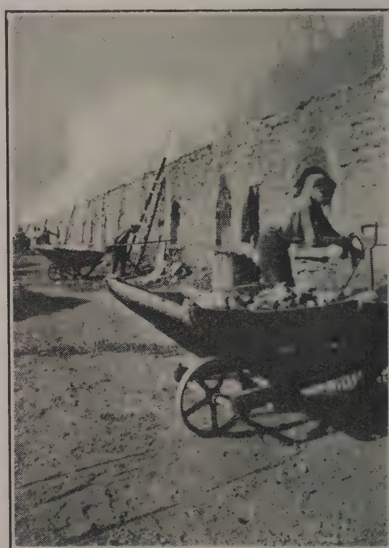
The time necessary to complete the coking process varies with the grade to be manufactured. If it is to be foundry coke, it requires 72 hours; if furnace coke, it requires 48 hours, from the time of catching up to the point where the process is completed. The point regarding foundry and furnace coke will be taken up later.

The coke is ready to be pulled as soon as there are no more small candles of flame appearing on top of the glowing mass of coke. The door of the oven is opened by removing the bricks with a long hook, and the process of quenching is then begun. Coke is watered in the oven, and this accounts for the brilliant metallic appearance characteristic of Bee Hive coke. The amount of water required to properly quench an oven of coke varies from 1000 to 1500 gallons per oven, according to the size of the charge. Water is admitted into the oven by means of a long pipe made into a ring at one end, with holes on the lower side for the water exit. A hose is connected to the other end, which is coupled to a valve in a pipe line running along the battery of ovens. After the coke is quenched it is ready to be pulled.

The coke puller in starting to remove the coke from the oven uses a hook to draw the coke to the proximity of the door and jambs. A fork is used to lift the coke from the ground and place it in the buggy or large wheelbarrow, by means of which he rolls the coke into the car. When the hook will not reach the coke to break it down a short beaver is used, which rests on a grooved wheel supported by a sling from the cast iron door frame. The puller guides the beaver head into the vertical fissures of the mass and by jerking it breaks the coke into columns. He then withdraws the coke from the oven on to the ground, from where it is forked into the buggy. The time required to pull an oven is from two to three hours, including watering, but depends largely on the ability of the operator. After the charge has been drawn the puller sweeps the oven bottom clean, lays three rows of brick in the door opening, closes a sheet iron door and places a damper on the trunnel head. This is done to aid the reflection of heat from the crown bricks to the bottom tiles and to keep the heat in the oven from escaping by radiation. It is very important to keep the

Repairing Brick Work of Oven

Leveling the Charge



General View of Yard

Coke as It Comes From the Oven

oven as hot as possible before recharging, for by retaining this heat the new charge will catch up quicker and coal will be much better coked, reducing the quantity of "black butts," or coke with raw coal on the bottom. This great disadvantage to the quality of coke can be avoided by keeping the oven hot and not allowing the puller to open his oven before the coking process is completed.

One man usually attends two or three ovens. Six ovens is the usual number from which a single car is loaded. A runway is made to the track and the wheelbarrows are rolled from the ovens up this runway and dumped into the waiting cars.

A Bee Hive oven coke plant is usually run on a five or six-day basis, according to whether the coke is to be shipped as foundry or furnace coke. The batteries of ovens are built back to back, but staggered, and one side of the battery is pulled one day and the other the next day, as follows: Working on a five-day basis, or a foundry week, the coal charged Friday and Saturday the previous week will be pulled on Monday and Tuesday, respectively, as foundry coke. On Monday, the ovens will be charged with a light 48-hour charge, which will be pulled on Wednesday for furnace coke. On Tuesday the ovens will be charged with a 72-hour charge, to be pulled on Friday for foundry coke. Wednesday the ovens will receive a 72-hour charge, to be pulled on Saturday for foundry coke. Thursday will be a lay-off day, no ovens being pulled.

To start a dead, or cold oven, it is necessary to put in a light charge about 18 inches deep, and above this to build a large wood fire. After the fire heats the bricks to a glowing heat, and ignites the coal, the door is partly sealed, one brick being left out in the centre for the draught. When the oven has become very hot the door is sealed as before, and the oven is then in running condition, and it will never be necessary to build a fire in it again, as long as it is in blast, if it is given the proper attention.

The amount of coke yield per ton of coal varies with the per cent. volatile matter in the coal, and for high volatile coal ranges from 60 to 68 per cent. of the amount of coal charged.

The following facts will serve as a conclusion:

Diameter of oven, 12 feet.

Height of oven, 7½ to 8 feet.

Time of day work is started—12 A. M. to 2 A. M.

Time work is finished, about 2.30 P. M.

Ovens should be charged about three-quarters of an hour after being pulled.

Size of coke lumps received varies according to charge, and range from 20 to 40 inches. The bulk of the coke is, of course, in smaller lumps.

# The Towne Scientific School Journal

OF THE

## University of Pennsylvania

(WHITNEY MAGAZINE)

Published Quarterly by The Undergraduates of The Towne Scientific School

Subscription . . 25 Cents Per Copy, $1.00 Per Year

Entered as second-class matter Nov. 14th, 1914, at the Post Office at Philadelphia, Pa., under the act of March 3, 1879

Advertising Rates will be furnished upon application to the Business Manager.

Office Hours—1-2 P. M. Room 204, Engineering Building, 34th and Locust Street




## EDITORIAL

**Retrospect.**

With this issue of the JOURNAL the old board retires and the new board takes our place. Though they officially are next year's editors, their duties have begun with this number, and they have done most of the work of preparation.

The JOURNAL has now completed its second year of life as an organ of the Towne Scientific School. Though its advance has not been as rapid as we would wish, we feel that the magazine has not declined to any great extent. The road we have traveled has been a rocky one this year, as the sup-

port we have had from alumni and students has been none too strong. To make matters worse, the hard times in the industrial world have given us a struggle for advertisements which a long-established and well-known publication would not have. However, we hope for better things next year, and feel sure that the newly elected Journal staff will do much better than we have done. We have tried to broaden the magazine in its appeal and interest. Whether we have succeeded or not is not for us to judge, but we only hope that our successors will get as much pleasure, enjoyment and experience out of their work as we have.

**Making Vacations Count.**

Vacation will soon be here. Sooner than some of us wish; for that resolve which we made time and again during the year to "get right down to work from now on" has been side-tracked and lost in the excitement of relay races, baseball games and dances which have followed fast on one another.

What are YOU going to do with your summer?

Some of us have already signed up for the six weeks' trip to College Hall or the Harrison Lab., so that we can remove most or all of the conditions that the fates and our own neglect have brought us. Others are planning the camping trip which we will hear about all next winter when the Fireside League is not roasting one or more of the 'Varsity teams. Quite a number are going to do seashore or mountain stunts and learn how to play a good game of tennis or golf and get a heavy coat of sunburn.

A few have decided to work. They are going to get a position—that is, if the "boss" lives up to his promise and is still willing to take on any more helpers.

There are as many different ways of spending the summer as there are men to spend it, and some will employ it to their own advantage, while others will most certainly waste it entirely. Let us try as a whole to get some real return from our vacation; something that will have a lasting and tangible value to us in years to come.

If we are resolved to make the most of our holidays we might draw up a set of resolutions like those which we formulate at New Year's, mid-years and at other times during the year; but see if these can't be kept a bit longer than the rest.

First—DON'T WASTE YOUR TIME!

In spite of all the improvements of modern science, man has as yet found no way of recovering lost minutes from the scrap heap of wasted opportunities. From the 16th of June

to the 24th of September there are 99 days! That means 99 chances to do a good day's work and to get something out of life.

Second—KEEP YOUR EYES OPEN!

It is harder to see the little things than the big self-evident ones which no one could miss. You wouldn't bump into a desk in the drawing-room with your eyes open, but you might step on a thumb-tack. This is an age of little things; the ones that count. It is often that the utilization of the by-products determines whether an article can pay for itself or not. Make the little things count. When you find fifteen minutes on your hands, stop figuring the percentages of the home teams "win or lose"; take up some worth-while book and improve your style. The English of the average graduate of a technical school shows little if any improvement over the work done in high school. Wait until you are writing to the "manager" for a position and you will regret that you took all those cuts in English composition. There are many little tricks of advertising yourself; a good letter is one of the best that a man can use until he has a "rep." at his command.

Third—LEARN THE WHY AND HOW!

Theory and practice go hand in hand. One without the other means that you never arrive at the top. How many inches of bar iron will make a ring with a six-inch radius? You know it is $2 \pi R$ or 37½ inches. But ask a blacksmith. He will tell you "three times the diameter plus twice the thickness of the bar, plus the lap." He can't tell you if 700 degrees is the right heat to temper tool steel, but he can tell you the color that gives the best result.

The man at the forge or the drawing table knows the HOW but not the WHY—the engineering graduate who is still getting $15 a week after ten years with the firm couldn't apply the WHY to the HOW.

Fourth—LOOK AHEAD!

Don't think because you say good-bye to the Engineering Building for three months that it should drop out of your life entirely. Some of you will have theses to write next year, and next spring will be a poor time to start looking around for a subject. Look ahead now. A number feel that the year has taken all the strength out of them; but unless they take advantage of the summer to rest and become strong and healthy again they may have to take the time in the middle of the winter, when they cannot afford the luxury of being sick.

Begin now to look ahead and MAKE YOUR VACATION COUNT.

It is a common saying that "Ignorance of the law excuses no one," and the same statement applies to the knowledge which people have of their surroundings.

**Practice of Observation.**

Considering the importance, particularly as applied to engineering, of the habit of keen observation, it is surprising how little this faculty is cultivated.

Many students go through four years of college, spending the majority of their time in one building, yet at the end of that period are unable to give an adequate description of its general appearance, interior arrangement, decoration or equipment.

After graduation, when the practical work begins, it is the man with powers of observation that makes good when sent out to give a report on a piece of work, and it is his ability to see quickly and clearly what is needed, and how to make use of the materials already at hand, that make him valuable to his employer.

A man who has not developed or used his powers of observation is sent out on a job, and without noticing any materials on the spot, orders the necessary, and a lot of unnecessary, supplies.

The result is, the cost of the operation is materially increased and the company stands a chance of having a rival concern discover the unnecessary expense, advancing it as a business argument in their favor, which of course is a legitimate point to make.

It goes without saying that no company will keep a man in their employ who is losing business for them.

In connection with the practice of observation, a certain amount of curiosity is essential, for unless a man takes pains to discover things for himself he will lose that power of keen observation which forms one of his most valuable business assets.

**Activities.**

The student who goes through the University without "going out" for a team, or trying for the cast or chorus of a play, or without being a "heeler" for one of the publications misses to a great extent the benefits that such competition offers. It is the spirit of competition that brings out the very best in a man. The time-honored excuse of "I haven't time" often means "I haven't the ambition," for the old saying of where there's a will there's a way has been proven true too often. If a man has set his heart on his work, he is bound to succeed, no matter what happens or who opposes him. He may not become a record-breaker if he decides to run, nor make the board of the maga-

zine he "heels"; but the confidence in himself which he acquires more than repays him for the work.

Interdepartment activities offer a place for those who feel that they would never rise beyond the "scrubs" or the "second string" if they tried for 'Varsity teams. Baseball, football, basketball and rowing are on the schedule. Interdepartment matches occur during the various seasons, and these sports offer a welcome relief from the drudgery of "gym." classes. During the winter various plays are produced and the lucky dancing choruses receive gym. credit for their weeks of practicing. Publications are not able to hold forth this desired credit, but the value of the experience cannot be over-estimated. The man trying for the business department learns how to approach prospective customers; how to sell, and how to buy; while the editorial "heeler" learns the value of a good letter or article, and finds that correct style and a good choice of words will take him much farther than mere bodily strength when he is hunting a good paying position.

**Next Year's Play.**

The play's the thing! No matter how clever the actors may be, the whole success of a play depends upon the plot and on the lines. The plot may be small, but the lines must be clever or it will fail. Clever plays are not written in a day—even by a master genius. Next year we will want a clever play—or maybe two clever plays, though the passing of the Grub Street Theatre makes the production of an Architectural play look dubious. Perhaps the suggestion of a Towne School play, made just after the Engineers' show, will be carried out. It is certain that if shows of such merit as "The Topaz Tulip," "Where There's a Will There's a Way" and "Sherman Said It" can be produced by the individual departments, a combined Towne School play might easily rival the Mask and Wig.

If you have a plot, work it into a play during the summer. If you can compose, try your hand during vacation—catchy songs and dreamy waltzes will be needed next winter, and a good play, one that is worthy of the Towne School, will be the result.

## Election.

The Journal takes pleasure in announcing the election of the following men to constitute the Editorial Board and business staff for the following year.

Editor-in-Chief—**W. H. Williams Skerrett,** M.E., '16.
Associate Editor-in-Chief—**Eugene Gilbert,** Arch. S.P. '15.
Architecture—**George M. D. Lewis**, Arch. '16.
Civil Engineering—**Edwyn L. Shoemaker**, C.E. '17.
Chemical Engineering—**Earl A. Shrader**, Ch.E. '16.
Electrical Engineering—**Clifford L. Fenton**, E.E. '16.
Mechanical Engineering—**Frank A. Epps**, M.E. '16.
Alumni Editor—**J. P. Eyre Price**, Ch.E. '16.
Business Manager—**Robert P. Marshall**, M.E. '16.
Assistant Business Managers—**Frank C. Hamilton**, M.E. '16; **Paul E. Sigmund, Jr.**, C.E. '16.
Circulation Manager—**Oliver H. Paxson, Jr.**, E.E. '16.
Assistants—**O. C. Wagenknight**, C.E. '18; **H. V. Ryder**, E.E. '18.

---

**Mr. Frederick W. Taylor**, who received the honorary degree of Doctor of Science from the University in 1906, on the occasion of the dedication of the Engineering Building—at which function he was one of the speakers—died on March 31, 1915, at th eage of 59.

In a tribute to Mr. Taylor's memory in a recent issue of the "Engineering News" it is stated that "although his death occurs at a comparatively early age, **Mr. Taylor** had fully completed the great task of his life. His great achievement was the introduction to the engineering profession and to the industrial world of what has come to be known, for want of a better name, as scientific management."

Mr. Taylor was a past president of the American Society of Mechanical Engineers, an honorary member of the Society for Promotion of the Science of Management and a member of the American Philosophical Society.


At the sixteenth annual convention of the American Railway Engineering Association held at Chicago, March 16 to 19, 1915, there were in attendance the following graduates of the University of Pennsylvania:

**C. E. Lindsay,** Division Engineer N. Y. C. .............. '84
**A. B. Cuthbert,** Assistant Engineer P. R. R. .............. '86
**J. R. Savage,** Chief Engineer L. I. R. .................... '88
**O. P. Chamberlain,** Chief Engineer C. & T. W. ............ '89
**R. L. Humphrey,** Construction Engineer ................. '91
**J. B. Austin, Jr.,** Superintendent L. I. R. ................ '94
**P. H. Wilson** ......................................... '01
**H. Bortin,** Valuation Engineer U. P. R. R. ............... '07
**Prof. E. L. Ingram,** Assistant Professor C.E., U. of P.
**H. C. Ives,** Ex. Inst., U. of P.

These men met at noon, March 17th, and took lunch with the following Pennsylvania graduates of the Chicago Alumni Association:

**Dr. Guilford, '91.**
**G. A. E. Kohler, '86.**
**J. W. Hoover, '00.**
**T. H. Pratt, '03.**
**G. W. Adams, '05.**
**M. L. Emig, '08**
**E. L. Green, '08.**
**A. L. Foster, '10.**

Plans were made for increasing the interest of Pennsylvania graduates in the American Railway Engineering Association and of Pennsylvania Alumni in the Chicago Alumni Association.

**Mr. C. E. Lindsay,** Division Engineer of the N. Y. C. at Albany, B.S. '84, C.E. '85, was elected a director of the Association at this convention.

**Mr. W. L. Saunders,** B.S. (Mi.) '76, and Sc.D. '11, president of the Ingersoll-Rand Company, New York City, has

recently been honored through his election to the presidency of the American Institute of Mining Engineers.

**Samuel Tobias Wagner,** B.S. '81, C.E. '84, formerly assistant engineer of the Philadelphia & Reading Railway Company, has recently been appointed chief engineer of that road, succeeding Mr. W. Hunter, deceased.

**Mr. C. E. Lindsay**, B.S. (C.E.) '84, and C.E. '85, division engineer of the New York Central Railroad, has been elected to the presidency of the Eastern New York Alumni Society of the University of Pennsylvania.

**Mr. J. P. J. Williams**, B.S. (C.E.) '98, and C.E. '08, has accepted an associate editor-ship on the editorial staff of the "Engineering Record," New York City. Mr. Williams' chief responsibility will be for articles on structural engineering subjects. A noteworthy article by Mr. Williams on "Wind Stresses in Skew Bridges" appeared in the "Engineering News" of April 1, 1915.

**Dr. William McClellan**, B.S. '00, Ph.D. '03, who recently received the degree of E.E. at the University, has been nominated to the vice presidency of the A.I.E.E.

**Mr. E. W. Deakin**, B.S. in C.E. '01, formerly local manager of the Otis Elevator Company, Washington, D. C., is now the local manager of that company in Philadelphia.

**Mr. W. P. Taylor**, B.S. '00, C.E. '02, formerly division engineer, Bureau of Highways, has been appointed principal assistant engineer in that bureau.

**Mr. H. E. Hilts**, B.S. in C.E. '05, road engineer, Association of American Portland Cement Manufacturers, recently addressed the Civil Engineering Society of the University on the subject of "The Uses and Abuses of Concrete," illustrated by lantern slides and motion pictures.

**Mr. Harvey C. Deaver**, B.S. in C.E. '08, manager service department, Otis Elevator Company, has been elected secretary-treasurer of the New England Alumni Society of the University of Pennsylvania.

**Mr. George S. Koyl**, M.S. '11, B.S. '10, who recently returned to this country, exhibited his drawings at the University. His studies of Hadrian's Villa, which was his principal work while abroad, are still on exhibition in the department. Mr. Koyl is now teaching design at the Carnegie Institute of Technology.

**Mr. Edward Glass**, Sp. '12, and **Mr. Charles Butner**, Sp. '12, have opened architectural offices in the Republican Building, Fresno, Cal., under the name of "Glass & Butner."

**Mr.** and **Mrs. A. DeF. Cowperthwaite**, Ch.E. '13, announce the arrival of a baby boy, A. D. C., Jr. He will be registered in the class of 1936, Ch.E.

**Mr. P. C. Gunion, '14** Ch.E., was married early in February to a Washington girl. "Phil" is now manager of the by-product department of the Philadelphia Suburban Gas Company, located in Chester, Pa.

**Mr. William George Mann**, B.S. '14, was married in Centralia, Wash., on March 31st to Miss Edith V. Lemon.

**"The Synchronizer,"** a small sheet published by the Mechanical, Electrical and Chemical Engineers of the class of '12, appear this current month. It is a very cleverly arranged leaflet, edited once a year and telling of the positions and place of residence of the members of the class. The spirit of the thing is to be highly commended, for it keeps the whole class in touch with each of the individual members.

# SENIOR TRIPS

## Senior Mechanical Trip.

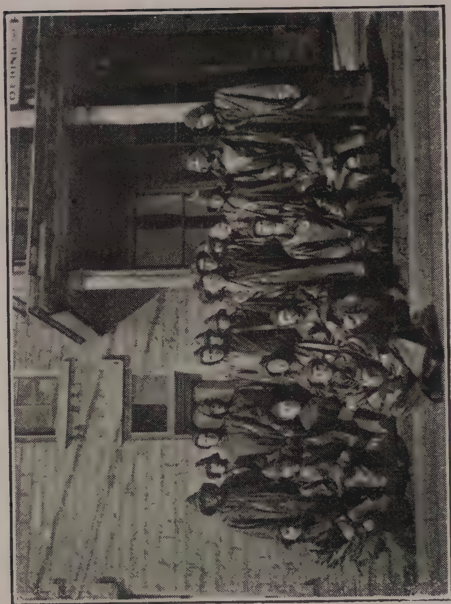
The inspection trip of the Senior Mechanical Engineering Class was a great success. Under the experienced guidance of Professor Fernold, we traveled through the Middle West from March 18th to 31st inclusive, visiting the principal large industrial plants of the country. It certainly was a broadening influence for our technical course, and I think every one enjoyed it to the utmost.

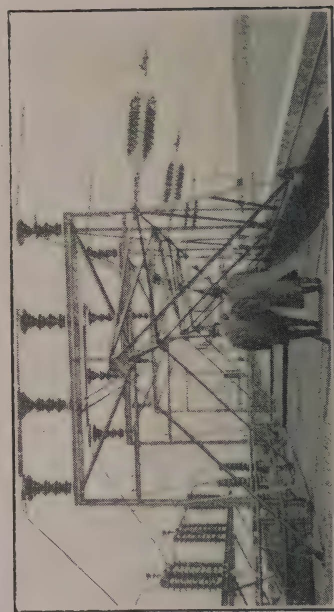
We left Broad Street Station at 8.40 on Thursday evening, March 18th, in a private car. There was lots of fun that first night, and not much sleep for some people. It was this night on the train when Jensen discovered many extraordinary things about a sleeper. For instance, he found that there were lights for every section, which appeared when you pushed a button, and also that there was a hammock in which you could sleep in case the night was warm.

On arriving at Pittsburgh we found a hard day ahead of us, with four plants to visit. These were the Westinghouse Machine Company, Westinghouse Electric and Manufacturing Company, Jones & Loughlin Steel Company and the National Tube Company. They were all exceedingly interesting places, but we felt that we had walked at least a thousand miles, and most of us were rather weary when we were finished. The next day was an easy one, however, for we went out to Greensburg and inspected the Crow's Nest Mine of the Keystone Coal and Coke Company. We all dressed as miners, with electric lights in our caps, and descended into the darkness to bump our heads every nine paces. We learned that in every car of coal that was brought out of the mine there were 13 rats. It sounds funny, but it is true, because we found it in Leopold's notebook when we got back. Apparently this mine is so well protected by safety devices that they never have any but miner (minor) accidents.

We left Pittsburgh that night after holding the train for some time while Wright and Twining said good-night to some of their Pittsburgh friends. It was on this ride to Cleveland that Sellers made the discovery that steam heating pipes in a Pullman car are quite hot and called Moffly's attention to the fact.

In Cleveland we had Sunday to ourselves. Then we started in Monday to "do up" another town, and incidentally ourselves, too. We first inspected the Peerless Automobile Factory, after which we were invited to stay to lunch and dine on Peerless "truck." That afternoon we rode out to Akron, O., and rubbered (!) at the Goodrich plant. It was such a large place that we all got tired (!) and a few people missed the train home. If





any one desires to hear a vivid description of Akron I advise them to ask Marshall, for he has tender memories of the place. He liked the spirit of the town.

The next day we were shown through the White Sewing Machine Factory and the automobile works next door. In the latter place, like the Peerless Company, they were busy on a war order of two-ton (Teuton) trucks for the Germans. After seeing the Cleveland pumping station and municipal electric light plant in the afternoon we took the train for St. Louis—that is, all except five, who unfortunately had to return to Philadelphia, through faults not their own, and inspect a few home products.

The first plant we struck in St. Louis was the power station of the Union Electric Light and Power Company. Here, as in other places visited, our official humorist, Frank Tinney Holl, made the governors and other power plant employes laugh by exclaiming at the top of his voice, "Boiler furnaces are great (grate), but Oh, you Roney stoker!"

Two remarkable things happened in St. Louis. One of them was that Bartol went to bed at a reasonable hour, and the other was that Brown was on time one morning and ready to start when Dr. Fernold was. Some of the members of the party may deny this last statement, but I know it to be true, for he gave me a dollar to say so.

We saw Hamilton Brown shoes being manufactured and went through the Union Station power plant, signal towers, etc., before we left St. Louis. We also went out to Alton, Ill., and visited the largest bottle factory in the world. As we passed through one portion of a building where they were making half-pint bottles Bartol scratched his initials on one of them, with the result that the betting was even money that he would get the flask before he was 40.

We left St. Louis at 2.30 A. M. for Keokuk. We made the train all right, but Moffly insisted that he had left something on the station platform, though we never found out what it was. However, it was rumored that it was a grape fruit he had bought for a midnight feast on the train.

We all liked Keokuk. The power station was a good proposition, as we all could see by running down the columns of statistics, etc., and by looking over the general layout of the plant. We discovered in the "Hotel Iowa" that pink collars are being worn on men this spring; a rather new idea for us.

From Keokuk we proceeded to Chicago via chair car. Here we stayed several days and saw quite a number of interesting things. After going through the Corn Exchange Bank Building we went down to Gary and ran a Marathon around the property of the Indiana Steel Company. A big man in a blue uniform won the race, but I neglected to ask who he was or why he ran with

us. After the race we all got a shine in the beautiful town built up on the sand dunes. We were later told that the price of shoe polish was doubled in Gary that day.

The next two visits were made to well-known places. The first was Sears, Roebuck & Co., chiefly notable for Patterson's eloquent speech after we had been given a delicious luncheon by the firm. The other plant was that of the Commonwealth Edison Company, which was the scene of a great disaster. Leopold lost his notebook for 15 minutes and he had every stoker in the place looking for it.

We had a terrible time getting Patterson away from Chicago, and it was only by brute force that we finally succeeded. We next went to Detroit to see the Parke, Davis & Company's laboratories and the Ford Motor Company's factory. The former will be remembered for its presents of tooth paste and cigars, while the latter place didn't even give us a machine. They did give us an opportunity to sleep in a nice dark room in a nice hard chair, with nothing to bother us but a movie camera.

The next day we visited Niagara Falls and the power houses thereabouts. We also saw a few miles of shredded wheat in the famous breakfast food factory.

It was while crossing the bridge over the Niagara River, when we were passing some Canadian soldiers, that Donald Brian Shoemaker, "the vici kid," was heard to shout, "Hoch der Kaiser!" and then run. Nothing came of the episode, however, much to our relief, and we all returned to Philadelphia safely.

One word on Professor Fernold before I close. He certainly treated us well, and, thanks to his foresight and experience, the arrangements and plans were carried out as smoothly as on a regular Cook's tour.

## SENIOR ELECTRICAL TRIP.

The first required inspection trip for Senior Electrical Engineers covered a period of eight days, beginning March 24th at Philadelphia and ending March 31st in New York.

Probably two months before the time set for the start of the trip the more progressive members of the class began to pester the head of the department for details concerning the schedule arranged and to discuss the advisability of taking along evening clothes and an extra trunk for their afternoon shoes.

The first morning saw every one on time for the train. The wonder of this can only be appreciated by those who take the roll in the 9 o'clock lecture courses.

The McCall's Ferry power station, which was scheduled for the first day, is located on the Susquehanna River, about 20 miles below Columbia, and furnishes power to Lancaster and Baltimore.

The plant represents a very modern, low head development;

all construction work is of concrete and steel. The dam, which is 65 feet high and 2400 feet long, forms a lake five miles long and three-fourths of a mile wide.

The capacity of the station is about 85,000 K. W., and this power is transmitted at 70,000 volts to the cities before mentioned for local distribution.

One of the interesting features of this plant is a $25,000 concrete fishway. This fishway is built to government design and is utterly useless, as no fish found in these waters could ever climb it with a ladder. The fishway was built after a model used at the St. Louis Exposition to show the acrobatic ability of the Alaska salmon. These fish mount waterfalls and like obstacles as a daily pleasure and found the fishway easy to climb. However, when used in Pennsylvania streams, where the fish are less energetic, an observer would not need to be a student of fish life and habits to know that the fishway could never answer its purpose. The fish problem is solved by a natural fall on the York county side of the dam having a more gradual slope. This serves to illustrate the money that must be thus spent to solve what an engineer may think a small problem.

The party received every courtesy at the hands of all the men connected with the plant and great credit must be given Mr. Bauhm, the superintendent, for having assembled a very competent force of engineers.

Thursday morning the party arrived in Pittsburgh, and after a hasty breakfast boarded a train for East Pittsburgh to inspect the plant of the Westinghouse Electric and Machine Company.

The trip through this plant was known to the party as the 20-mile jaunt, and every one was thoroughly tired out before they arrived at the Fort Pitt in the evening.

The party was invited to attend a smoker given at the Westinghouse Club in the evening.

The following morning the plant of the Union Switch and Signal Company was visited. This plant is devoted to the manufacture of automatic signals for railway work and has very modern shops and machinery.

In the afternoon the party went through the plant of the Carnegie Steel Company at Holmestead and the Carrie furnaces.

On Friday night our party joined Professor Scott and a party from Scheffield Scientific School, Yale, who were also on an inspection trip. After introductions and a few hearty cheers we started on the night run to Buffalo.

Not all of us, however, for it is rumored that visions of Flying Dutchmen (schooners) and other pleasures of the Smoky City detained some of the party past train time. At any rate, it afforded us great amusement to see Knopf and Millar enter the

Hotel Imperial at Niagara Falls late the next afternoon after spending the day on the trains trying to catch up with our party.

The falls are beautiful at this time of the year on account of the ice formations, and the party thoroughly enjoyed the Sunday given over to rest and sightseeing. Some of the more adventurous took a trip under the falls and were amply repaid for the risks they ran by the beautiful views obtained from this point. "Bill" Zimmerman was almost lost to the party on this day, when he was seized by a customs inspector while endeavoring to enter Canada; he was rescued at great risk.

On Sunday night we returned to Buffalo and all gathered early, 1 o'clock, for the grand presentation of medals which was heralded to occur at this time. These medals had been prepared in Niagara Falls at great expense by a syndicate having Messrs. Chappell and Millar as directing spirits and were presented to the honored members of the class with appropriate speeches. Because of the modest bearing of those so honored it has been thought best to refrain from a detailed report of the occasion.

At the plant of the General Electric Company in Schenectady we were taken through the buildings by some Penn graduates who are at present working with the company.

A dinner was given to the party Monday evening at the Mohawk Golf Club by several old grads. of the neighborhood.

Several spirited bowling and billiard matches, in which the faculty took a very active part and showed great skill, occupied the time before the dinner.

The dinner was a huge success. Mr. Rice acted as toastmaster and introduced the different loyal alumni. All these men were of the type to which Pennsylvania points with pride, and had a real message for us. A most interesting talk was given by Mr. Whitney, who has charge of the research laboratories of the General Electric Company. Mr. Whitney told of the work which is being done and which they have hopes of doing in such a way that every one felt more friendly towards pure science than they had since entering Freshman Physics. Moving pictures ended the evening's pleasure.

The party was by this time too tired to sleep, and it was decided that the last night on the sleeper should be devoted to further promoting good fellowship in the class. After first ascertaining that Doc Shaw still had his pass the signal was given to start proceedings. Mel Doolittle, usually a moving spirit in all such escapades, had selected this night for sleeping, and when he came in the path of the marauders fiercely resented their intrusion with extreme violence, whereupon Mr. Doolittle was locked so tightly in his upper berth that even the porter, with the help of a key, had trouble in releasing him.

The concluding days in New York consisted in inspecting

the Westinghouse Lamp Works at Watsessing, N. J., the Newark plant of the same company, the Engineering Societies' Building and two steam electric stations in New York City.

Much credit must be given to Professor Clewell, who had active charge of the trip, for a thoroughness in arranging details and a promoting of good fellowship in the party, which contributed more than any one factor toward making the trip an assured success.

If future parties which he may direct derive as much benefit and enjoyment from the presonal contact which a trip like this affords as did our party Professor Clewell may feel well repaid for his work in this branch of education.


## ARCHITECTURE

Men from the department have secured three out of the four places in the preliminary competition for the Roman Fellowship. This fellowship, which carries with it $3000, is awarded by the American Academy in Rome and entitles the holder to three years of study and travel abroad.

Much credit is due to the students who have remained in the competition, for they have had to compete with men from over the entire country, as any architect, student or draftsman in the United States is eligible. They are Miles B. Dechant, John F. Harbeson and Malcolm E. Graham.

This excellent showing by the department is practically a repetition of last year's record, when all of the final contestants were for the University. In 1914 the prize was awarded to William J. H. Hough, of Ambler, who is now pursuing his professional studies in Rome.

The Stewardson Memorial Scholarship will again come to the University, as the five competitors and both alternates are Pennsylvanians. Herbert Dean, N. V. Taylor, Wilmer Rabenold, Eugene B. Baker and D. Supowitz; first alternate, John F. Harbeson; second alternate, Theodore F. Dillon.

The old Dental School opposite the Engineering Building is being placed into shape for the Department of Architecture. The plans call for extensive changes in the arrangements of rooms, painting and exterior finish, and a modern system of artificial illumination is to be installed.

---

## FACULTY

Prof. E. L. Ingram, professor of railroad engineering and geodesy in the Department of Civil Engineering, has recently been elected to fellowship in the American Association for the Advancement of Science.

Professor Ingram was in attendance at the sixteenth annual convention of the American Railway Engineering Association, which was held in Chicago March 16th-18th.

Dr. Harold Pender has been nominated for membership on the Board of Managers of the A. I. E. E.

The National Committee on Factory Lighting of the Illuminating Engineering Society, of which Prof. C. E. Clewell is chairman, met in Philadelphia at the University Club on April 23d. In addition to the regular committee, Dr. Harold Pender, Mr. Wm. J. Serrill, '83; Mr. C. O. Bond, of Philadelphia; Mr. L. B. Marks, of New York, and Prof. G. A. Hoadley, of Swarthmore, attended the meeting. A Factory Lighting Code for State legislation, on which the committee has been at work for some time, was ratified at this meeting.

---

## CHEMICAL ENGINEERING PERSONALS

President Kirchner had a successful season on the gym. team, where he performed creditably upon the parallel bars.

"Josh" Price, Ch.E. '15, was a member of the scrub football team and won his numerals for consistent work.

T. R. Palmer, Ch.E. '15, is again a member of the 'Varsity track squad, doing his part as broad jumper in good form.

"Tommy" Evans, Ch.E. '15, has just passed through a most successful season as leader of the University Mandolin Club.

E. Smiley, Ch.E. '16, was a member of the fencing team and was awarded his insignia at the close of the season.

E. A. Shrader, Ch.E. '17, has been running on the indoor track team and is now on the 'Varsity squad for spring training.

Edward TenBroeck, Ch.E. '17, and Allison Eyster, Ch.E. '17, were both members of the indoor rifle team which finished in second place in the Non-Military College League, and are now candidates for the outdoor team.

William F. Whalen, Ch.E. '17, has for the third successive year made the chorus of the Mask and Wig show.

The Chemical Engineers' baseball team is now in existence and has played one game with Haddonfield (N. J.) High School, and would like to play some of the other departments, especially the Civils.

During the Easter holidays a number of the Sophomore class walked from Houston Club to Valley Forge, Pa., and after six hours on the road, with many amusing experiences, arrived at their destination.

Hahn and White, both Ch.E. '18, are at present rowing in the second Freshman crew.

The annual elections of the Priestly Chemical Society will be held in the near future and plans for next year's work will be discussed at that time.

---

## "INTERDEPARTMENT RACE"

Rowing on the Schuylkill was enlivened on April 17th by the interdepartmental race of the Towne Scientific School. For more than a month practice has been held to prepare the men for the event, which resulted in a victory for the Architects, with the Electrical, Mechanical and Civil Engineers following in the order named. The race was held in barges over the three-quarter-mile course, finishing at the Columbia avenue bridge.

Coach Nickalls acted as referee, starting the race from his launch. At the word "go" the boats sprang away, the Electricals taking a slight lead. This was increased, and at the end of the first quarter-mile they were a length ahead of the second crew, the Architects. From this point on the contest resolved itself into two races, the Architects and Electricals fighting it out for first place, with the Mechanicals and Civils two lengths in the rear battling to keep from finishing last.

A quarter of a mile from the bridge the Architects overtook the Electricals, and, after a hard fight, nosed them out at the finish by a quarter of a length. The Mechanicals, in third place, were about the same distance in front of the Civils, but there were two lengths of open water separating them from the first two boats.

The Architects' line-up was:

Bow—Morgan
No. 2—Zirpel
No. 3—Mahnken
No. 4—Law
No. 5—Wieland
No. 6—Kayll
No. 7—Wolfe
Stroke—Shefchik
Cox—Murray

## HONOR MEN

James Carlton Patterson, M.E. '15, otherwise known as "Jimmy," was chosen Bowlman of the Senior Class at the election in the early part of April. Besides furnishing the second honor man, the Engineering Department also gave the fourth honor man, Horace Butler, E.E. '15, who was elected Spade man.

Patterson is from Baltimore, Md., entering the University from Baltimore City College. He was captain of the Freshman track team and has been a 'Varsity runner for the last

three years. He won the 100-yard dash Intercollegiate championship in 1913 and is possessor of the Holden 100-yard dash record. He is president of the Christian Association, having been actively interested in Christian Association work during his entire college year. Patterson is president of the Senior Class and a member of the Phi Kappa Beta Junior Society, the Sphinx Senior Society and the Kappa Sigma Fraternity.

Butler is from West Chester, Pa., and entered from Haverford School. As a Freshman he was a member of the Freshman football team and the class crew. Following up his work at crew, he rowed in the 'Varsity boat in his Sophomore and Junior years. He is now filling the position of No. 2 in the Varsity eight. Butler is a member of the Phi Kappa Beta Junior Society, the Sphinx Senior Society and of the Delta Psi Fraternity.

## ELECTRICAL ENGINEERING

Extensive tests on various systems of artificial lighting for the drafting rooms of the Engineering Building have been conducted by the electrical staff during the past month. A system of semi-indirect illumination with nitrogen-filled Mazda lamps has been selected and is to be installed by May 10, 1915.

## THE COMBINED SOCIETIES' DANCE

On the evening of April 28th the Engineering Building was the scene of the Combined Engineering Societies' annual dance. In a beautifully-decorated ballroom and to the best music to be obtained in Philadelphia, the large gathering made the affair both a social and financial success.

The large lecture room was transformed into a fairyland by long festoons of light and vine-covered trellises hid the long coils of steam pipes. Large canvases at each end of the room relieved the painted walls and the ballustrades in front of the musicians and the patronesses' box changed the room entirely.

At midnight a delicious supper was served, and from the number of absentees at nine o'clock classes the next morning the men must have enjoyed staying till the last dance in the wee small hours.

The success of the affair was due to the work of the committees and the enthusiastic support of the student body.

## ENGINEERING DANCE COMMITTEE.

Treas., Maull, '15, E. E. Chr., Jack, '15, E. E.

MUSIC—Tourtellotte, McMichael.

PROGRAMS—Patterson, Harris, Fowle, Calhoun.

REFRESHMENTS—Millar, Scheetz, Murphy.

DECORATIONS—Hughes, Moore, Renninger, Whitby, Bryant, Shoemaker, Baker, Hamilton, Peopes.

PATRONESSES—Duncan, Bartol, Chadbourne, Black, Epps, Rudolph, Turner, Gotwals, McCall, Randall, Tilden, Sellers.

## ENGINEERS' BANQUET

All out—all out! Everybody down at Kugler's on Wednesday, May 12th, for the banquet. It's going to be the party of the year. No deadwood—every minute will be a happy one. Where do the actors eat? We don't know; but we can tell you that every Engineer with a bit of red blood in his veins is going to be at the "Big Eats" on the 12th.

You may not dance, perhaps you don't care for musical shows, of the movies at the societies' meetings, but you have to eat—you can't go through your exams. unless you get a good, big feed!

Come out! If you don't enjoy the banquet you can bring it back and we'll refund the money. **Two** dollars is all it will cost to have the time of your life. Come and get together and know the men in the Towne School.